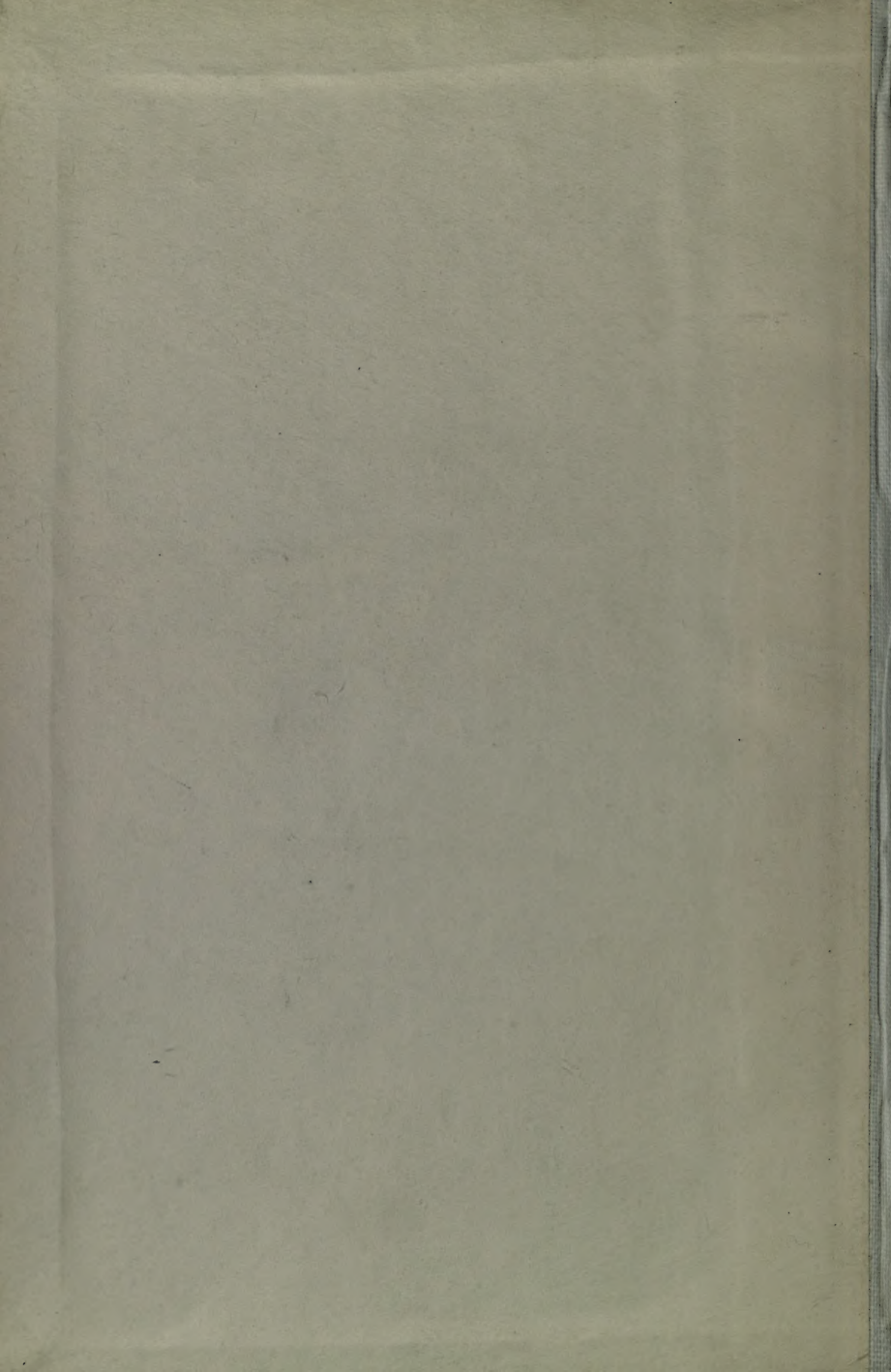
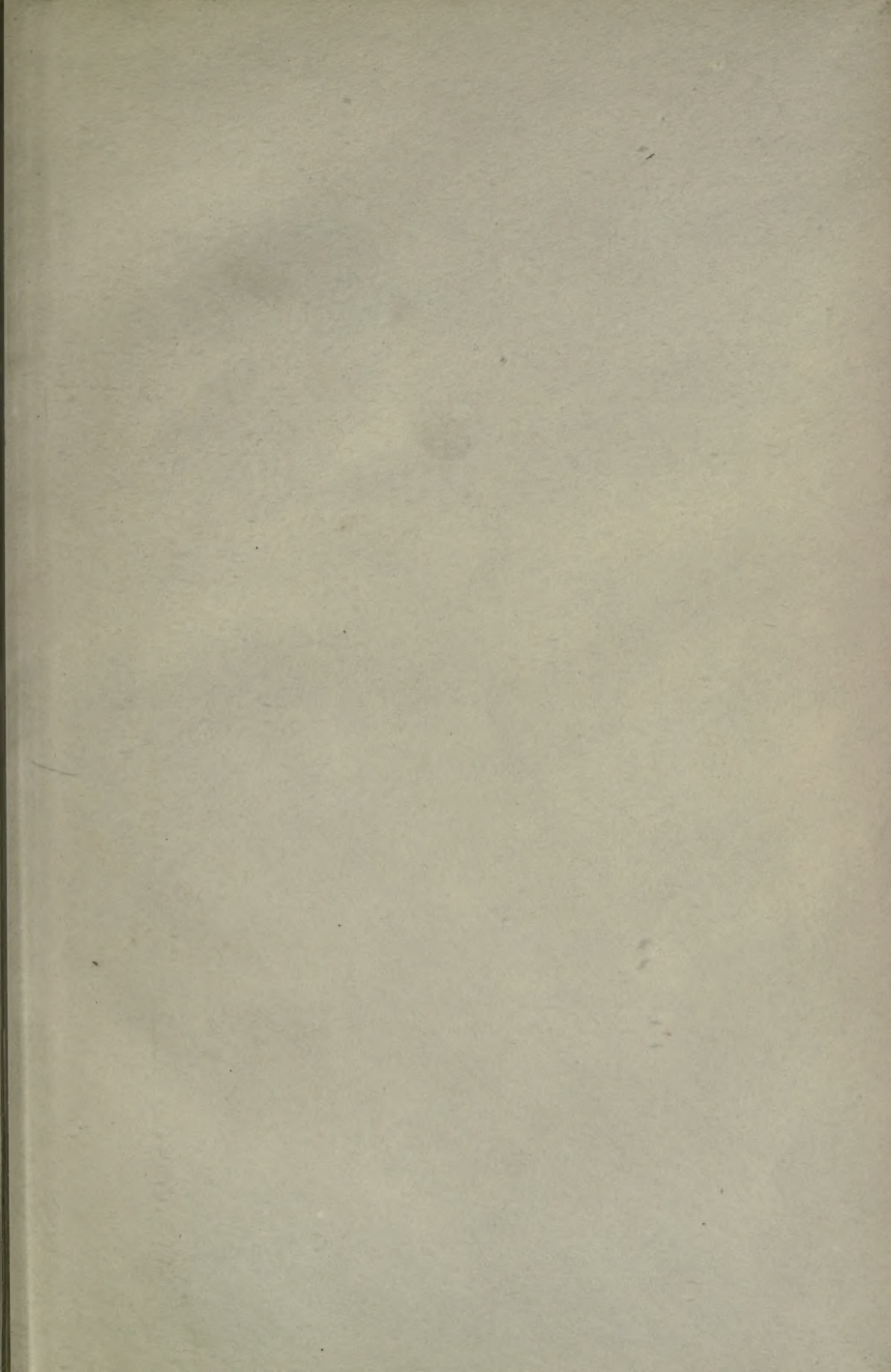




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CEREBRAL AND OPHTHALMIC
COMPLICATIONS
IN
SPHENOIDAL SINUSITIS.

BY

STCLAIR THOMSON, M.D., F.R.C.P. LOND.,
F.R.C.S. ENG.

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*Reprinted from the 'Transactions of the Medical Society of London,'
vol. xxix, 1906.*

LONDON :
HARRISON AND SONS, ST. MARTIN'S LANE, W.C.,
PRINTERS IN ORDINARY TO HIS MAJESTY.

1906.

CEREBRAL AND OPHTHALMIC COMPLICATIONS IN SPHENOIDAL SINUSITIS.

A CONTRIBUTION FOUNDED ON TWO CASES WITH AUTOPSIES.

By STCLAIR THOMSON, M.D., F.R.C.P. Lond.,
F.R.C.S. Eng.

INTRODUCTORY.

The frequent origin of intra-cranial complications from suppuration in the ear is now generally appreciated, but a similar association has not yet been fully established between the brain and the nose.

Scanty Researches of Cerebral Infection from the Nasal Sinuses.—Indeed, some researches would imply that such a relationship is comparatively rare. Gowers considers that nasal disease is an occasional, but rare, cause of cerebral abscess.* Treitel looked through the records of 6,000 autopsies, and found 21 cases of cerebral abscess. Of these, seven originated from the ear, and three from suppuration in the frontal, or the frontal and ethmoidal cavities.† Wertheim found 127 instances of intra-cranial suppuration in the records of 10,394 *post-mortems*, and 14 were stated to be of nasal origin.‡ Although an analysis of 9,000 autopsies in Guy's Hospital revealed 57 cases of intra-cranial mischief from ear disease, Newton Pitt could only find one case of cerebral abscess due to nasal suppuration.§

But we have only to recollect the frequency with which pus is met with in the nasal accessory cavities at *post-mortem*, and how commonly many infectious diseases are complicated with meningitis, to prepare us for the possibility of this association being more frequently demonstrated when the accessory sinuses of the nose are systematically examined in all *post-mortems* of cases with intra-cranial inflammatory lesions.

* 'Diseases of the Nervous System,' vol. ii, 1893.

† 'Berliner klinische Wochenschrift,' No. 51, December 21st, 1893, p. 1139, and 'Zeitschrift für Ohrenheilkunde,' Bd. 27, 1895, p. 32.

‡ 'Archiv für Laryngologie,' Bd. XI, 1900.

§ 'British Medical Journal,' 1890, vol. i, pp. 643, 771, and 827.

FREQUENCY OF NASAL SUPPURATION.

The *post-mortem* observations of Harke,* E. Fraenkel,* Lapelle and Martin,* and Kiaer† furnish us with statistics which showed sinus disease in 30 per cent. of all subjects coming to the dead-house. T. S. Kirkland, of Sydney, examined 22 subjects who had died

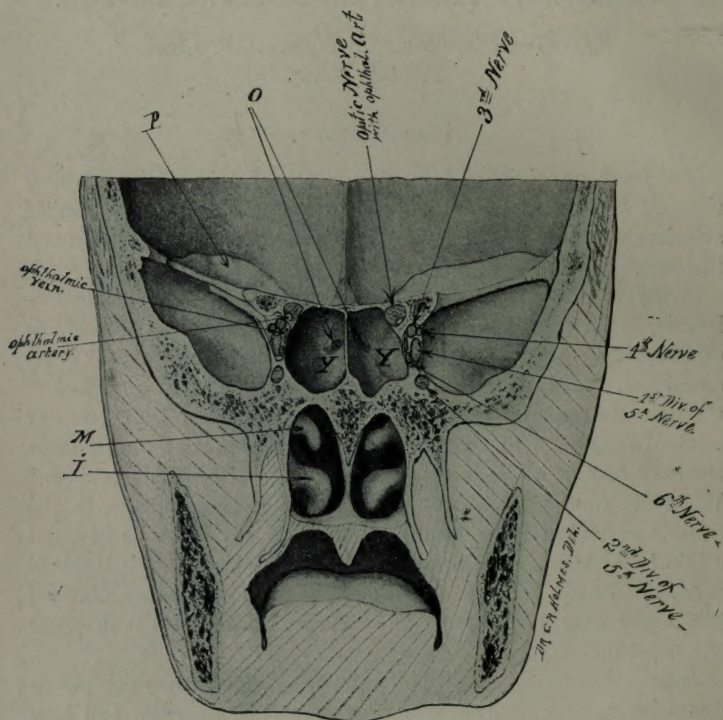


FIG. 1.—Frozen section of anterior half of head, cut immediately in front of chiasma. Viewed from behind: *P*, orbital roof of frontal sinus; *O*, ostium sphenoidale; *YY*, right and left sphenoidal cavities; *IM*, inferior and middle turbinals.

from pneumonia, and in 11 of these (*i.e.*, 50 per cent.) pus was found in one or more accessory cavities, and always in the sphenoidal sinus.‡ Many statistics agree that the sphenoidal sinus is, next to the maxillary, the most frequently diseased; and, as

* Quoted by F. Martin, 'De la Fréquence de l'Empyème,' Bordeaux, 1900.

† 'The Laryngoscope,' 1899, vol. vi, No. 2, p. 81.

‡ 'Journal of Laryngology,' vol. xvii, No. 11, November, 1902.

Lermoyez observes, "sphenoidal suppuration is not rare ; it is only its diagnosis which is uncommon." This frequency of sphenoidal sinus disease certainly suggests a new field for research in the etiology of intra-cranial infections, particularly when we recollect the anatomical configuration of the sphenoidal cavities and their connection with the orbit, the optic canal, the cavernous sinuses and its contents, and the base of the brain. This association is well shown in the drawing of a transverse section, for which I am indebted to my friend C. R. Holmes, of Cincinnati. (Fig. 1.)

AUTHOR'S TWO CASES.

In the two cases which I am able to put on record, the sphenoidal origin of intra-cranial suppuration is fully established. In one case it assumed the form of acute, suppurative basic meningitis ; and in the other, that of thrombo-phlebitis of the cavernous sinus. In both cases the diagnosis was made during life, and was confirmed by *post-mortem* examination. I will give the records of both cases, before offering any comments or deductions.

CASE 1 (No. 17 in the Bibliography, *vide* Appendix, p. 30). *Sphenoidal Sinusitis. Acute Suppurative Meningitis. Death. Autopsy*.—F. D., a working man, aged 36, was sent to me at the Royal Ear Hospital on April 26th, 1901, by Dr. George Wale, of Croydon, for pain in the head, with a history of ear trouble. He said that the right ear drum had been ruptured by a blow two years previously. A month before admission to the hospital he was attacked with influenza and acute earache on the left side. Dr. Wale, on seeing him on March 26th, was struck by his look of extreme illness, and his marked sleeplessness. The left drum ruptured about March 29th, and he went on syringing it for a fortnight and returned to work. When seen on April 19th, he complained of intense frontal headache and also of a recurrence of deep-seated pain referred to his left ear ; but Dr. Wale could find nothing there to explain it, and so sent him up to my clinic. He had not told Dr. Wale anything about nose trouble, but on admission to the hospital he gave a history of discharge from the nose for "as long as he could remember," with occasional severe headaches. The discharge ran chiefly into the back of his throat. He said there was no bad smell in his nose, but that the discharge had occasionally tasted bad, and for the previous fortnight—since he had felt so much worse and almost sleepless from pain—it had tasted worse.

His headaches had been chiefly frontal. They began about 9.30 in the morning and left him about 3.30 in the afternoon ; recently his headaches had also been referred to the lower occipital and left temporal region. We heard, later, that his "pals" had looked upon him as "a bit off his head" at times.

The first thing that struck me was his stricken look of severe illness. He was very pale. Pulse 92. Temperature 98.8°. The pupils were not dilated, but were equal and reacted normally. There was no vomiting, rigors, or staggering.

Ears.—The right drum was quite normal, and showed an old inferior

cicatrix. The left drum was perforated and exuded a slight, mucoid, non-fetid discharge. The posterior half was still bulging, and was therefore incised.

Nose.—The left nasal chamber was quite healthy. In the right the middle turbinal was hypertrophied, with some inflammatory thickening in the ethmoid region, and there was curdy pus on the roof of the cavum pharyngeum on the right side.

The diagnosis was made of septic infection, and probably early meningitis, from suppuration in the right sphenoidal sinus.

Next day—April 27th—it was noted that he had hardly slept on account of the headache. The temperature was still normal; but on the following day it had gone up to $102^{\circ}2$. He had not slept all night from the severe headache “behind the eyes and on top of the head.” He complained of a “rotten egg” taste from the back of the nose; and the nasal conditions were confirmed on re-examination.

His nose was well cleansed regularly, and he was given calomel and chloral.

On the third and fourth days after his admission, the temperature varied from 100° to 101° . The pulse varied; it was noted once to be 62. The heart and lung sounds were normal. There was no tenderness over or below the mastoids, and the discharge from the left ear had, under antiseptic treatment, become very slight, and the drum was closing.

His mental condition was rapidly changing; he became irrational, dull, and indifferent, and the nurses found it difficult to keep him in order or “get anything out of him.”

I decided that it was useless to open his sphenoidal sinus, as diffuse meningitis must have already started. I saw no reason to operate on either ear.

On April 30th—his sixth day in hospital—his temperature was 101° . He had been restless all night, getting out of bed, and trying to dress himself. His cerebration was slow, and it was difficult to hold any communication with him. He complained of being deaf and that everything was misty before him. There was diplopia, with left internal strabismus, and occasional nystagmus. The pupils were medium, the right somewhat dilated. The optic discs were slightly hazy. During the day the patient became very deaf, and only answered questions when roared at. The right membrana tympani remained as when previously examined. The left one was seen to be closing; it was not bulging or injected. There was no mastoid tenderness on either side. The tuning-fork appeared to be hardly audible by conduction, on the right side, but was still heard on the left. He could swallow well, and kept asking for drink. Marked right facial paralysis developed. The temperature was 102° to 103° ; the pulse 98; the arteries were noted to be thickened. On the following day, May 1st, it was noted that the left pupil was more dilated than the right. He was intelligent at times, but gradually became more comatose and died that evening—a week after he had walked to the hospital.

I regret that there is no mention of the urine, but I think it must have been free from albuminuria, or the fact would have been noted.

At the *post-mortem* examination there was a large quantity of pus at the base of the brain, more copious on the right side, and tracking up to the vertex. Upon removing the brain there was no evidence of extradural abscess, or of caries or necrosis in the middle or anterior fossæ of the skull. The nasal accessory sinuses were laid open by an antero-posterior saw cut, passing into the foramen magnum behind, and down to

the glabella in front. The cut passed a little to the left of the middle line, and permitted the two halves of the skull to be opened like a book, and the sinuses to be examined from above downwards.

As the right sphenoidal sinus was opened a quantity of muco-pus escaped from it into the naso-pharynx, which was seen to be bathed in the same sort of secretion. The lining of the sinus was thickened, purplish, and sodden, instead of being thin, white, and glistening like the inside of an oyster, which is the condition in health, a condition which was found in all the other accessory sinuses on both sides.

The temporal bones were removed and the middle ear was subsequently found to be quite healthy. The brain was normal, except for the suppurative meningitis already described. The pus from the base of the brain was seen extending down the spinal canal. No evidence of disease was met with in the thoracic or abdominal viscera.

Although there was in this case no macroscopic evidence of direct meningeal infection, there can be no doubt that the patient died from infection of the meninges from pus in the right sphenoidal sinus, where there had long been a latent suppuration which had lately been re-inforced in virulence by influenzal infection. In many of these cerebral infections—whether of aural, ophthalmic, or nasal origin—infection appears to spread by the lymphatics, so that instead of a local infection by contiguity, a veritable sowing of the cerebro-spinal fluid with microbes takes place.

CASE 2 (No 21 in the Bibliography, *vide* Appendix, p. 30). *Sphenoidal Sinusitis. Streptococcal Infection. Purulent Thrombosis of the Cavernous and other Venous Sinuses of the Skull. Marked Proptosis and Chemosis from Retro-Ocular Abscess. Death. Autopsy. Duration 33 days.*—A strong, healthy-looking scullery maid, aged 16, complained of pain on the top of her head on February 6th, 1905, and during the following days she was sick, had a shivering attack, and her eyelids were noticed to be swelling. On February 13th she was first seen by Mr. W. F. Lace, of Sutton-at-Hone, to whom we are much indebted for his careful notes of the early stages.

The eyeballs were then prominent, and there was some chemosis of the right conjunctiva. Eyesight was normal. The pupils were equal and small. Both upper eyelids were tense, discoloured, and œdematous looking. There was tenderness on pressure at the upper and inner angle of the right orbit. Temperature 102° to 105° .

There was no history of blow, sting, or other local infection; no evidence of any ear mischief; and, although enquired for, there was no abnormal nasal discharge.

During the next five days the temperature remained high, even reaching 105° , while the pulse varied from 90 to 116. Stiffness of right side of neck, backache, and a general feeling of soreness were complained of, together with inability to turn over in bed. On the 11th day of her illness distinct fullness and tenderness was detected along the right sterno-mastoid muscle, but no glands could be felt.

On the 13th day of her illness the patient was admitted to King's College Hospital, under Mr. Boyce Barrow. When left alone she lay perfectly quiet on her back; she appeared rather sleepy, but was quite rational

and all her senses were normal. Any attempt to raise her head, or turn her to one side, excited pain in the neck and back of the head. The proptosis and chemosis were so marked (Fig. 2) that the eyelids could not be closed. The right upper eyelid was reddish purple and œdematous, while the chemotic conjunctiva projected above the lower eyelid, and was dry and commencing to ulcerate from exposure. The left upper eyelid was discoloured and less swollen, and the conjunctiva, although protruding slightly, was not ulcerated but simply dry. Optic neuritis was found by Mr. Cargill to be present in both eyes.

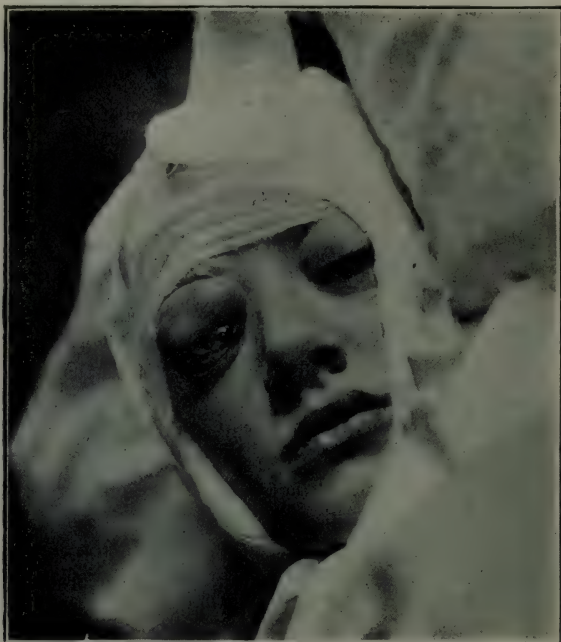


FIG. 2.—Thrombosis of the Cavernous Sinus (Case II). Shows the œdema of the eyelids, proptosis, chemosis, ophthalmoplegia, and commencing ulceration of the conjunctiva.

The ears were examined by Mr. Arthur Cheatle, and found to be quite normal. There was no swelling or tenderness over any of the nasal accessory sinuses, but on examining the nose I found pure pus on the right side far back in the middle meatus, and descending from the olfactory cleft. On the left side there was some muco-pus deep in the middle meatus. The general condition of the patient prevented an inspection of the post-nasal space, or the application of the tests by transillumination, posture, &c.

The patient was quite rational and very clear on the point that she had never had a discharge or any disagreeable smell from the nose, neither had she been subject to headaches.

Although the pus in the middle meatus might come from any of the accessory sinuses, I had no doubt, in view of the proptosis, that the right and possibly the left sphenoidal sinuses were diseased, and had caused purulent thrombosis of the cavernous sinus.

Examination of other organs added nothing to our information. There were no physical signs in the chest or abdomen; the spleen was not enlarged; the urine was healthy. The tongue was moist, and there was no sickness. The leucocytes numbered 36,000.

There were two rigors within 24 hours of admission, the temperature running up to nearly 106° , while the respirations were 28, and the pulse 116 (*vide* Chart, p. 9).

As the large, smooth, elastic swelling in the upper part of the neck on the right side—under the sterno-mastoid—had become more marked, Mr. Barrow decided to explore it under a general anæsthetic. This was done on February 21st (*i.e.*, two days after admission and the 15th day of the illness). No definite abscess cavity was found, but a large number of glands with numerous points of pus in them were explored and removed. The right jugular vein was explored, and was not thrombosed. There were no symptoms on the left side of the neck.

While the patient was under the anæsthetic, Mr. Barrow kindly invited me to further explore the nose, and carry out any procedure I thought desirable. With the aid of Killian's long nasal speculum the middle meatus and the olfactory cleft on the right side were cleaned and inspected. It was then quite easy to see the ostium of the sphenoidal sinus, with pure yellow pus oozing from it. The middle turbinal was therefore removed, the front wall of this sinus was broken down with Grünwald's forceps, and the opening further enlarged with Volkmann's sharp spoons. The sinus was seen to contain pus and thick mucus. This was all wiped out, and the cavity was lightly packed with a strip of iodoform ribbon gauze. It was not expected that the patient would allow this to remain in long, and she pulled it from her nose the next morning. However, she permitted the house surgeon to syringe the sphenoidal sinus twice daily, and he had no difficulty in introducing a large Eustachian catheter into it to a depth of 3 inches from the anterior naris.

The orifices of the sinuses on the left side—and particularly that of the sphenoidal—were inspected in the same manner, but only some slightly purulent mucus was seen, and as there was no recurrence when it was wiped away, it was decided to leave that side alone.

These procedures confirmed the diagnosis as to the original point of infection, but no improvement was expected to result from them—and none occurred. The proptosis and chemosis became more marked (Fig. 2). The pupils were equal and reacted to light; sometimes they were found widely dilated, and at other times they were medium sized. The congestion of the upper lids became so intense that it was impossible to raise them, and owing to the proptosis it was difficult to estimate the amount of movement in the eyeball. But paralysis of the sixth nerve developed, and weakness of all the other ocular muscles on the right side. Ten days later (*i.e.*, on March 3rd) Mr. Barrow made incisions through the conjunctiva and evacuated pus from behind the eyeball on each side.

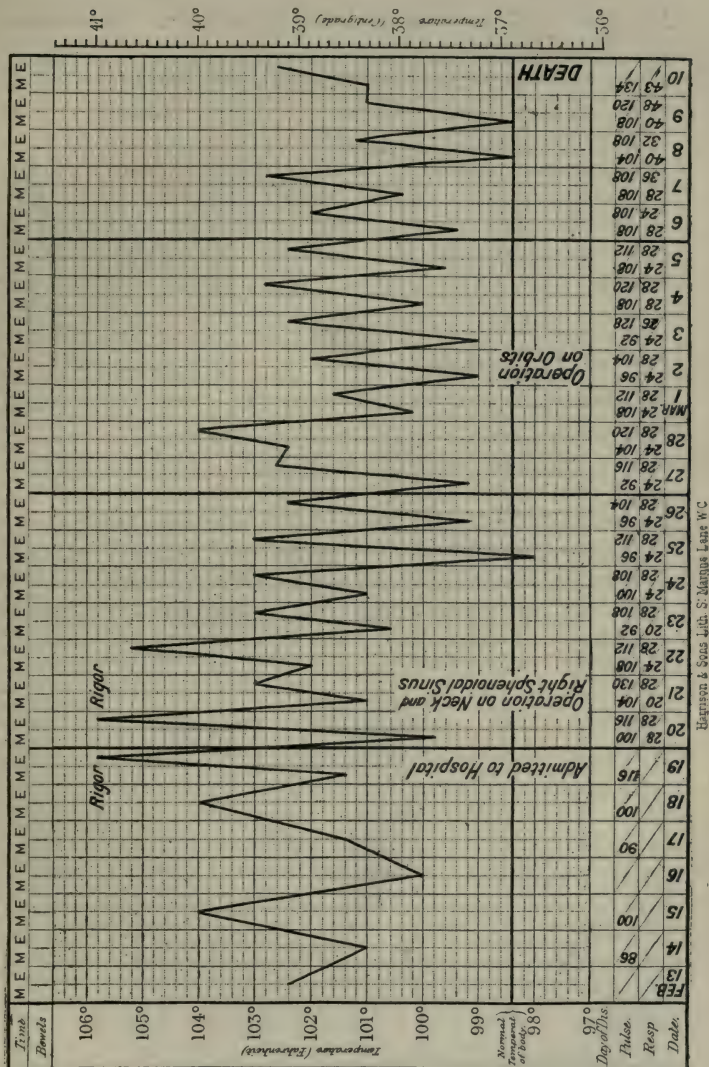
Bacterioscopic examination of this pus, made by Dr. Emery, showed a very large number of streptococci in long chains, which were matted together to form tangled skeins. No other organisms were seen. Swabs were inserted into the right sphenoidal sinus and removed covered with muco-pus. This was found to contain large numbers of streptococci, and a few staphylococci. Cultures of blood removed from the right basilic vein remained sterile.

In view of the fact that the original focus of infection was now freely drained, and that the purulent thrombosis was so extensive, it was deemed useless to try the effect of anti-streptococcic serum. There was no recurrence of vomiting or rigors, but, although conscious, the patient became more irritable, and apt to cry out with the pains "all over her." The conjunctiva commenced to ulcerate, and some opacity commenced in the right cornea. Weakness and drowsiness increased; the respirations became quick and irregular; and without any development of fresh symptoms the patient died on March 10th—about a month from her earliest symptoms, and a little over a fortnight from the opening of her sphenoidal sinus.

The *post-mortem* examination was made by Dr. Dalton 21 hours after death. On removing the skull cap there were no signs of meningitis, but a trace of pus was found below the membranes at the base of the cerebellum. This had probably escaped from the right petrosal sinus which had been wounded in cutting through the tentorium. The cavernous sinuses, the petrosal sinuses, and the lateral sinuses were filled with almost undiluted yellow pus. The pus in the right cavernous sinus was mixed with red blood. The superior longitudinal sinus was normal. There was no disease visible in the floor of the middle or anterior fossæ of the skull.

On opening the nasal accessory cavities the following sinuses were found quite healthy, viz., both frontals, both anterior ethmoidal cells, and both maxillary antra. The left sphenoidal sinus was not much larger than a pea, and it and the adjoining posterior ethmoidal cells showed traces of apparently recent muco-pus. There was no visible alteration in the mucous membranes. The right sphenoidal sinus was big enough to hold the end of the little finger. (The sphenoidal sinus is not fully developed before the age of 20 to 25 years—this patient's age was 16.) Its mucous membrane was discoloured, grayish, thickened and studded with polypoid hypertrophies. Its bony walls were also grayish in colour, but not appreciably softened. It contained some pus, but most of its secretion had apparently drained into the post-nasal space, as the pharynx was full of yellow muco-pus. In its anterior wall was the free opening made during life. A portion of the bony wall and mucous membrane was removed for microscopic examination and several cultures were taken. The adjoining posterior ethmoidal cells were not visibly altered and contained a little muco-pus. There was also pus at the back of both orbits. The thoracic and abdominal viscera were normal.

Pus taken from many situations—both sphenoidal sinuses, both cavernous sinuses, the right petrosal sinus, both orbits around the optic nerves, &c.—was found in all cases to contain streptococci similar to those seen during life. In film preparations they appeared quite pure, but a few contaminations occurred in the cultures. Sections of the sphenoidal mucosa, made by Dr. R. Lee and examined by Dr. Emery, showed it to be a pyogenic membrane containing streptococci.



DISEASE.

Notes of Case,

H.

Name Lily

Age 17

Diet

Case Book No.

SPHENOIDAL SINUSITIS
THROMBOSIS OF
CAVERNOUS SINUS.

Highest & lowest
daily temperatures.

Date of Admission,
13th February, 1905.
Result: Death.

My best thanks are due to Mr. Barrow for allowing me to publish this case, and to his house surgeon, Mr. Gompertz, for the care with which he followed it, and the notes he has kindly supplied.

REMARKS.

Several conclusions would be justified from the record of these two cases alone, but they would hardly suffice to construct a clinical picture of the cerebral complication arising from pus in the sphenoidal sinus, and, of course, any conclusions would be more justified if they could be confirmed by other observers. The evidence demonstrating the possibility of cerebral infection from sphenoidal suppuration is of recent date. Less than 20 years ago the very extensive researches of Berger and Tyrman only revealed one case in which death was due to this infection.* It was that of Demarquay (No. 2, *vide* Appendix). I have, therefore, made a search through literature, and though doubtless incomplete, I trust the result may help to a more general recognition of the conditions under consideration. This would appear to be the first effort in English to demonstrate that a sphenoidal origin of cerebral infection is not uncommon, although in German we have the excellent monograph of R. Dreyfus† and for many references I am indebted to the very full article of my French colleague, Dr. Toubert.‡

The present collection of cases is also the largest which has yet been made: Dreyfus, in 1896, recorded 13 cases, and Toubert, in 1900, gave epitomes of 24. My researches have yielded 40 cases, in addition to my own, in which death from intra-cranial complications was due to septic infection from the sphenoidal sinus. In these 42 records, there is only one in which the relationship was not fully established by a *post-mortem* examination (Case 28), but in it the condition of the sphenoidal sinus and the symptoms of thrombosis of the cavernous sinus leave no doubt as to the diagnosis. In a few cases the clinical records are scanty, or even wanting; but, on the other hand, they are very full and clear in the majority of cases, and the *post-mortem* records are generally complete. In selecting

* 'Die Krankheiten der Keilbeinhöhle,' &c., Wiesbaden, 1886.

† 'Die Krankheiten des Gehirns und seiner Adnexa im Gefolge von Nasenerkrankungen.' G. Fischer, Jena, 1896.

‡ 'Archives Générales de Médecine,' vol. clxxxvi, 1900, p. 385.

these cases I have rejected all others in which the cerebral invasion was due to traumatism of the sphenoidal sinus, tumours originating in it or traversing it, syphilitic, tubercular,* or other specific processes, or where there was any possibility of the intra-cranial complications being due to suppuration in any other accessory cavity.† I have also omitted those in which the sphenoidal sinus simply showed disease during the spread of infection from the nasal to the cranial cavity, as occurs in the course of sporadic or epidemic cerebro-spinal meningitis or meningo-encephalitis.

As regards the ophthalmic complications, only those have been considered which were associated with the cerebral invasion. I have not included cases where the sphenoidal sinusitis affected the eye only, and fatal consequences did not therefore ensue.‡

These 40 cases are so extremely interesting and instructive that I have made a rather full abstract of them. But I have placed them in an appendix to this article, where they can readily be consulted by those who wish to verify the conclusions I have drawn from them. They are arranged in chronological order, in different groups according to the most prominent intra-cranial lesion. With the addition of my own two cases, they yield 42 cases, which fall under the following headings:—

Meningitis.—In 17 cases this was the only, or the predominant, lesion.

Thrombosis of the Cavernous Sinus.—In 4 cases, including my second one, this was the primary complication.

Thrombosis and Meningitis.—In 13 cases, although the thrombosis was the principal lesion, it was associated with basic meningitis. With the addition of the previous 4 cases of thrombosis, we see that either thrombosis of the cavernous sinus, or basic meningitis, may result with equal frequency as a complication of sphenoidal suppuration.

Intra-cranial Abscess.—One case.

Meningeal Septicæmia.—Two cases. This title is given by Toubert to cases where the anatomical changes are trifling or even entirely

* Lewy, 'Thèse de Wurzburg,' 1892. Quoted by Moreau (Case 34).

† K. Störk, "Die Erkrankungen der Nase, des Rachens, &c.," Wien, 1895, p. 239; J. Broeckaert, 'Annales des maladies de l'Oreille,' vol. xx, 1904, No. 12, p. 1288.

‡ Oscar Eversbusch, 'Graefe-Saemisch Handbuch der Gesamten Augenheilkunde,' Zweite Auflage, Kapitel xvi. Leipzig.

absent, and where cerebral death is due to sphenoidal infection, generally occurring rapidly (2 to 7 days).

Encysted Abscess of Dura Mater.—One case.

Hæmorrhagic Encephalitis (part of a general Septicæmia).—One case.

Phlebitis of the Cavernous Sinus (giving rise to Pyæmia).—One case.

Intra-cranial Hæmorrhage.—One case.

Suppurative Encephalitis.—One case.

SYMPTOMS OF SPHENOIDAL SINUSITIS.

Discharge.—The symptoms of sphenoidal suppuration can only be briefly referred to, and in so far as they lead up to the study of cerebral complications. In numerous cases the symptoms are vague, and many are common to pus in any of the accessory cavities. They may be grouped into three classes, as they affect (*a*) neighbouring regions, (*b*) more distant organs (digestive tube, lower respiratory tract, etc.), or (*c*) the general health.

As regards the sphenoidal sinus, the most common symptom is that of more or less purulent catarrh, frequently post-nasal.

There may be cacosmia (Cases 17 and 24), or anosmia (Case 20). The nasal discharge may never be profuse (Case 41), or atrophic rhinitis may have been present for several years (Case 30). When the latency of the sinusitis is increased at times, other cavities may be temporarily roused to secrete muco-pus (Case 21), and cacosmia may then be present (Case 17). But a very striking and important fact is that patients may deny any nasal or post-nasal discharge (Cases 19 and 21), although the diseased mucous lining found *post-mortem* shows that the disease must have been of some standing. In patients of the working classes it is remarkable how indifferent they are to an amount of nasal or post-nasal muco-pus, which would often render miserable the lives of the more sensitive members of the leisured class. I have published the case of a factory girl who had pus in every accessory sinus of her nose, some of them particularly large, and yet she had given little attention to it, and only presented herself for treatment to the eye clinic when proptosis commenced.* Still more noteworthy is it that expert rhinologists, to whom the idea of sphenoidal suppuration occurred, failed to detect it. Thus, Beek notes the absence of pus (Case 33), Toubert carried out

* 'Lancet,' August 12th, 1905.

anterior and posterior rhinoscopy with care and no suspicion of sphenoidal disease was suggested (Case 11); while Bronner notes that there was "never much discharge from the nose, and on careful inspection absolutely no subjective or objective symptoms of disease of the sphenoidal sinus," except long-standing anosmia; yet the *post-mortem* showed both sphenoidal sinuses to be full of pus and granulation tissue (Case 20). Doubtless the explanation of this is that the outpouring of pus from the sinus may be intermittent, and that in many cases it is difficult to sound and wash out the cavity without a preliminary operation on the middle turbinal.

Pain or neuralgia may be absent, intermittent, or severe. Occasionally it resembles migraine. The pain of suppuration in a sphenoidal sinus is not referred to any regular and definite point. It may be frontal, occipital, or temporal. It may even be referred to the side of the head opposite the affected side. Sometimes it is said by the patient to be "in the ear" (Case 21), but as I have also been consulted by a patient with acute maxillary sinusitis for "earache," this location affords no definite help. Perhaps the only pain which is characteristic of sphenoidal disease is when the patient states that it is deep in behind the eyes. It may be so intense as to cause complete insomnia.

Pain may be entirely absent until the onset of endo-cranial infection. It is then rarely wanting, is generally acute, but varies much in distribution. This variation doubtless depends on the nerves involved in the extension. It may be on the vertex, at the back of the occiput, or deep behind the eyes. The latter is probably the only characteristic type. But extremely interesting, because so misleading in practice, are the cases in which the pain is distinctly located in some of the other accessory cavities. Thus in one case it was so fixed in the frontal sinus that the cavity was opened, only to be found healthy (Case 32). In the case of Rouge (Case 36) the pain was referred to the maxillary antrum; this was opened and found healthy, and the autopsy showed the sphenoidal sinus to be diseased. Pain behind the ear was complained of in two cases (Cases 15 and 24), while in no less than seven cases it was located in the ear itself (Cases 10, 14, 17, 19, 26, 30, 36). This pain was so marked that in three cases it led to the mastoid being opened (Nos. 14, 19, 30), and I would call particular attention to the fact that in each of these cases the operator was a skilled otologist. The symptoms were so suggestive of thrombosis of the sigmoid

sinus that this vein was opened in two cases (Nos. 19 and 30). It is to be remembered that otitis may coincidentally be present (Cases 11 and 36).

Fever is absent in chronic cases. It is generally present in acute or complicated cases, when rigors and other symptoms characterise the spread of septic infection beyond the sinuses.

General Symptoms.—The general health is more or less disturbed in all cases of nasal suppuration, either from direct absorption or from the penetration of pus into the respiratory or digestive tracts. It may be worth while calling attention to the appearance of the patient in some cases of sphenoidal disease. Although one of my cases was described as a strong, healthy-looking girl, the other impressed his medical attendant, Dr. Wale, with his look of extreme illness, and, on his admission to the Royal Ear Hospital, this pale, stricken look of severe illness was most noticeable. F. Furet points out that even extensive fronto-maxillary suppuration never brings about the chlorotic hue, the livid pallor, which is often observed in females suffering from this form of sinusitis. He also calls attention to the fact that disturbances of general health are apt to be particularly noticeable in sphenoidal sinusitis, and are not in relation either with the quantity of pus absorbed or with the local lesions.*

Affections Simulated by Cerebral Infection from the Sphenoidal Sinus.—It is interesting to tabulate the cases where the name of the disease for which the patient was admitted is given. This I find in 17 instances is as follows:—

Phlegmon of cheek—one case (No. 34).

Solid tumour of maxillary sinus—one case (No. 36).

Ear disease—four cases (Nos. 14, 17, 19, 30).

Frontal sinusitis—one case (Case 32, sinus opened, no pus).

Syphilitic periostitis of orbit—one case (No. 23).

Delirium tremens—two cases (Nos. 22 and 24).

Croupous pneumonia—one case (No. 6).

Acute miliary tuberculosis—one case (No. 37).

Tubercular meningitis—two cases (Nos. 31 and 42).

Tonsillitis and possible diphtheria—one case (No. 18).

Tetanus—one case (No. 3).

Typhoid fever—one case (No. 11).

* 'Bulletins de la Soc. Franc. d'Otologie et de Laryngologie,' Tome xvii, 1^{re} Partie, 1901.

SYMPTOMS OF CEREBRAL INFECTION.

Thrombosis of the Cavernous Sinus.—The onset of thrombosis of the cavernous sinus is indicated by various symptoms, which are well illustrated by the record of my own case. Frequently they are obscured by co-existing meningitis. Special attention might be directed to the following:—Pyæmic temperature, rapid pulse, and profuse perspiration usher in the spread of infection. Rigors occur in many cases (Nos. 18, 20, 21, 24, 25, 26, 30, 31). Headache is common (Nos. 18, 20, 21, 24, 25, 30, 31, 32, 33). It is generally acute, and sometimes the pain is referred to the side of the head (Nos. 25 and 33), to the back of the ear (No. 24), or to the frontal region (No. 32).

Sickness may occur (Nos. 21, 27, and 31), and its absence has been noted (No. 20).

Hebetude and delirium (No. 23) may pass into drowsiness or a torpid condition (Nos. 20, 21, and 26) and coma (19); or consciousness may be retained (Nos. 21 and 25). Convulsions may occur. Dysphagia has been noticed (No. 26). Inflammation of the glands of the neck was a comparatively early symptom in my own case (No. 21); swelling of the palate has been noted in one case (No. 31); and swelling of the cheek occurred in several (Nos. 22, 25, 26, 31, and 33). In cases so rapidly fatal that death may occur within three days, any eye symptoms are limited to one side and are so slight that a diagnosis is hardly possible (Case 19). The cavernous sinus may contain pus, but if not thrombosed, there is an absence of chemosis, proptosis, and ocular paralysis (Case 16).

Eye Symptoms of Thrombosis of the Cavernous Sinus.—But, generally, the possibility of thrombosis of the cavernous sinus is first suggested by the condition of the eyes. The three chief ophthalmic changes are (*a*) papillary oedema, (*b*) chemosis, and (*c*) exophthalmos. They develop within 6 (Case 20), 10 (Case 33), 12 (Case 34), or 16 (Case 30) days from the onset of symptoms indicating the spread of infection. It is possible that neither proptosis nor chemosis may occur in a rapidly fatal case (No. 19), yet both were noted in 14 cases (Nos. 18, 20, 21, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34). In three cases the oedema and proptosis diminished during the progress of the case (Nos. 23, 27, and 30). This proptosis and chemosis may be present on both sides when it is first noticed (Case 21), but it generally starts on one side and develops in the

other, 1 (Case 33), 2 (Case 34), 3 (Case 30), 5 (Case 25), or 6 (Case 20) days later.

There may be anæsthesia (No. 34), or ulceration of the conjunctiva (Nos. 20 and 21), or opacity of the cornea (Nos. 20, 21, 23, 24).

Paralysis of the ocular muscles generally occurs (Nos. 20, 21, 23, 24, 25, 26, 28, 30, 33, 34), but in one case the movements were good (No. 31). In Case 24 (James Russell) the ocular symptoms developed under observation, and followed each other in regular order, the proptosis not making its appearance till several hours after the orbital paralysis had become complete.

The condition of the pupils varies. They may be normal (Cases 19 and 31), unequal (Cases 23 and 27), small and not reacting to light (Case 18), dilated (Case 34), dilated and not reacting (Case 25), or, in medium dilatation, with only slight oscillation (Case 24). Doubtless the explanation of these observations lies in the fact, noted in my own case, that the condition of the pupils varies, for I sometimes found them equal and reacting, and at other times medium sized or widely dilated.

The fundus may be normal in rapid cases (Nos. 19 and 26) or at the commencement (Case 20). Later on there may be congestion of the retinal veins (Cases 20 and 28), papillary stasis (Cases 32 and 33), papillary œdema (Cases 25 and 34), papillary atrophy (Case 25), or optic neuritis (Case 21). The absence of papillitis (Case 20), or of swelling or neuritis (Case 31) has been observed.

It is difficult in most cases to test the vision; it may be good (Cases 20 and 31), or there may be complete blindness (Case 25).

Tenderness of the eyeball may be met with (Case 25).

Macewen fully describes thrombosis of the cavernous sinus, and states that it may be induced by infective inflammation in any of the nasal accessory sinuses; but he does not record any case in which the sphenoidal sinus was the primary source of infection.*

Henry Roth reports three cases of thrombosis of the cavernous sinus, one at the early age of 6, but without *post-mortem*. In none of them is there a report of examination of the ears, or of an exploration of the sphenoidal sinus.†

E. W. Dwight and H. H. German have reported four cases of

* 'Pyogenic Diseases of the Brain and Spinal Cord,' Glasgow, 1893, pp. 245-260.

† 'New York Medical Journal,' February 27th, 1904, p. 394.

thrombosis of the cavernous sinus, and state that two were infected from the skin of the face or neck, one from the middle ear, and one from the frontal sinus. They give a very complete bibliography of 178 other cases reported in literature.* But, unfortunately, the value of all these observations is greatly diminished by the absence in nearly all cases, of a clinical or *post-mortem* examination of the nasal accessory sinuses.

Only too often is the source of infection attributed to some lesion on the nose or upper lip, a carious tooth, or a phlegmon of the face or neck, when it is quite open to consideration that the true source was a collection of pus in the sphenoidal sinus, with its much more direct anatomical connections with the cavernous sinus. In one of Roth's cases this appears extremely likely. Thus, it is stated that the patient had a discharge of pus from the nose, and that the antrum and frontal sinus were opened and found to be healthy. Here, by a process of exclusion, it is rendered probable that the pus may have come from the one remaining large cavity, the sphenoidal.

Meningitis.—The onset of meningitis will be marked with the usual symptoms, though these will vary with the intensity and extent of the infection. I would, therefore, only draw attention to a few noteworthy points: While pain in the head is one of the most usual, yet this may be misleading, if it is referred to the ear, as it was in five instances (Cases 10, 14, 15, 17, 30). Rigidity and tenderness of the neck appear when the meningitis extends to the spinal cord (Case 16).

A change in the character of the patient may be an early and possibly misleading symptom. He may be thought crazy (No. 17). or become taciturn (No. 38), or irritable (Case 14).

The presence of albuminuria must not be allowed to disconcert the diagnosis (Cases 4, 24, 25, 27, 31). It may be slight (Case 31), and there may be hyaline casts (Case 4), although at the *post-mortem* the kidney shows only passive congestion (Case 24). The amount of albuminuria may even be considerable, while only traces of congestion are found afterwards in the kidney under the microscope (Case 26).

The evidence of the spread of sepsis was, in several cases, clinical only, and not pathological—rigors, delirium, high temperature, rapid tendency to sinking.

* 'Boston Medical Journal,' May 1st, 1902.

The eye symptoms in cases of meningitis due to sphenoidal supuration vary in different cases. Exophthalmos (Case 1), or immobility of the eye (Case 2), rarely occur. While the eyeball itself may not be tender, there may be pain on pressing it backwards (No. 1). Diplopia and nystagmus are met with (Cases 15 and 17). Strabismus may be present (Cases 14 and 17), or absent (Case 12). Ptosis may occur (Cases 3, 15 and 22).

The pupils may be equal and reacting (Case 15); large and reacting (Case 16); dilated (Cases 2, 3 and 8); unequal (Case 14); or more dilated on the affected side (Case 12). The retinal veins may be gorged (Case 14); and the optic nerve cloudy (Case 1) or congested (Cases 14 and 16).

The progress of the case, when intra-cranial infection has started, is sometimes very rapid. In one instance the patient was unconscious in 12 hours, and dead within 4 days (Case 12). In others death occurs at the end of five months (Case 36), 15 months (Case 35, intra-cerebral abscess) or $2\frac{1}{2}$ years (Case 38, encysted abscess).

In cases of meningitis death may occur between 4 and 35 days (Case 15), although it has been delayed for five months (Case 1). In cases of thrombosis the duration of the disease varies from five (Case 18) to 31 days (Case 20).

While death is generally directly due to the meningitis or sinus thrombosis, it may be brought about by intra-cranial (Case 41) or external hæmorrhage (Case 22).

PATHOLOGICAL ANATOMY.

The *post-mortem* findings will vary (*a*) according to the duration and extent of the disease in the sphenoidal sinus, and (*b*) according to the route, the intensity, and the extent of the cerebral infection. Of these 42 cases now published together, the source of the infection has been demonstrated by *post-mortem* to have been in the sphenoidal sinus in 41 instances; in the 42nd case this connection was proved during life. (Case 28.)

In most cases pus was found in the sphenoidal cavity. But this pus may have drained away just before or after death, or at the moment of making the autopsy (Case 17). In such instances confirmatory evidence of the sphenoidal sinusitis is found in the condition of its mucous lining or bony walls.

If the infection of the sinus is recent, and death occurs rapidly,

the mucosa may be quite healthy (Case 12). But generally the membrane shows degenerative changes, proving that the disease in the cavity is of some standing. (Cases 6, 7, 8, 10, 11, 13, 14, 17, 20, 21, 22, 23, 24, 27, 35, 41, 42). The lining of the sphenoidal sinus may even be found detached, and floating in pus (Cases 18, 24, 34, 42).

There was caries, necrosis, or osteo-myelitis of the bony walls of the sphenoidal sinus in a number of cases. Osteitis without perforation into the cranial cavity (Cases 18, 23, 34, 36), caries of the body of the sphenoid, which was quite rotten (Case 15), or softening of the sella turcica (Case 5), have been noted. Caries of the sphenoid bone on its cerebral surface has been observed (Cases 1, 16, 23, 26, 30, 31). Caries, with perforation of the roof or sides of the sphenoidal sinus, was found in 10 cases (Nos. 2, 6, 7, 8, 9, 10, 22, 25, 35, 41). But much more remarkable are the cases in which infection has spread from the sinus to the cerebral cavity, without any visible lesion of the anterior or middle fossæ (Cases 11, 12, 13, 17, 18, 19, 20, 21, 24, 34, 42).

The pituitary body may be surrounded with pus (Case 26), or may have become puriform (Cases 25, 34, 35). An abscess may be met with outside the dura (Cases 18 and 27), within the dura (Cases 22 and 24), between the layers of the dura (Case 38), or in the brain (Case 42).

Pus may be found at the apex of the orbit (Cases 20 and 21), or in the pterygo maxillary fossa (Case 34); and may occur in the middle ear (Cases 3, 11, 23, 36, 39). It is this coincident suppuration in the ear which has misled the diagnosis in some cases. Intracranial hæmorrhage is a lesion rarely met with (Cases 24 and 41).

Hæmorrhagic encephalitis—part of a general septicæmia—has occurred (Case 39). The cavernous sinus may present phlebitis, giving rise to pyæmia (Case 40); or its contents may be puriform without being thrombosed (Case 16).

The absence of gross lesions in the cranium may be associated with what Toubert describes as meningeal septicæmia—a condition which may occur in acute (Case 37) or in protracted (Case 36) cases.

The longitudinal sinus escapes in most cases. It is only noted in one instance (Case 5), where it was probably not infected from the sphenoidal sinus, but from an ulceration on the upper part of the vomer.

But the most common lesions met with in cerebral infections from the sphenoidal sinus are: Thrombosis of the cavernous sinus, and purulent basic meningitis. In two cases the thrombosis existed without any meningitis (Cases 20 and 21), while in two other cases it was slight (Cases 18 and 19). Meningitis had originated from the sphenoidal suppuration in 17 instances (Cases 1 to 17). In 14 of these the meningitis was the only intra-cranial lesion. In one case there was, in addition, thrombosis of the longitudinal sinus (Case 5); in a second case there was also an abscess in the frontal lobe (Case 6), and in a third there was pus in the cavernous and petrosal sinuses (Case 16). In 13 more cases thrombosis and meningitis existed together (Cases 22 to 34).

The pus was noted to be offensive in six cases (Nos. 8, 19, 24, 25, 30, 31).

Pneumonia was also present in one case, in which the tonsils were soft and infiltrated (No. 3). Finally, there may be the evidence of general pyæmia, originating from the sphenoidal sinus *via* the cavernous sinus (Case 40).

BACTERIOLOGY.

In several observations the infecting organism has been demonstrated. Pure cultures of streptococci have been obtained from the sphenoidal sinus and from the thrombus in the cavernous sinus (Case 21), or from the pus in the base of the brain (Cases 11 and 16). Staphylococci have been found in the sphenoidal cavity and in the blood—in both situations in pure culture (Case 40). Micrococci have been seen in the fluid removed by lumbar puncture, grouped in pairs, and in diplococci or in chains in the pus of the sphenoidal sinus (Case 12). The pneumococcus of Friedländer may occur in pure culture (Case 29). The pneumococcus occurs in the pus both of the sphenoidal sinus and the meninges (Case 4). In one case virulent diplococci pneumoniæ were found, not only in the sinus and the meninges, but also in the sphenoid bone itself (Case 18); and in another, a streptothrix was obtained from the meningeal pus (Case 15).

PATHOGENESIS.

In considering the evolution of these intra-cranial complications, space will not permit of our studying the etiology of sphenoidal sinusitis itself, so I would only draw attention to the records of four

cases which suggest that the pyogenic organism might originally have entered the system through the tonsil (Cases 3, 11, 18, 26).

In regard to the onset of endo-cranial complications we have to study why and how they occur.

Why? It would appear that the virulence of the microbe and the diminished resistance of the patient must be the chief factors. Neither the long duration, nor the degree of disease in the sphenoidal sinus, seem to cause it. In several cases, judging from the history, the sinusitis could not have been of old standing; and in my second case the pathological changes in the sinus were not very advanced.

Retention of discharge, from obstruction of the *ostium sphenoidale*, is often invoked as a cause. But in both the cases I record there was a free outpouring of pus, and Toubert noted that in one of his the orifice of the cavity was open (Case 13).

How? Perforation of the base of the skull, when it occurs, is sufficient to explain how the pus comes in direct contact with the meninges or venous sinuses. An abscess, extra- or intra-dural, may form the connecting link. More difficult is the explanation in those cases where this direct transference is not apparent. The suggestion that both endo-cranial and sphenoidal suppuration are due to the one general infection is not supported by a study of the *post-mortem* findings.

As to the route.—From the mucosa of the sphenoidal sinus to the subarachnoid space, there are three possible channels: (a) direct transference through the bone, (b) by the veins, or (c) by the lymphatics.

(a) *The route through the bone*, when it is destroyed by osteitis or necrosis, is evident. This channel of direct continuity is also demonstrated in the case of Ortmann (No. 18), where the bone was not perforated, but typical diplococci pneumoniae were found in the sphenoid bone itself—as well as in the pus of the meninges and of the sphenoidal sinus. Once the bone is invaded, the infection, of course, becomes much more serious, as diploe offers no resistance to its spread.

(b) *By the Veins.*—The possibility of this route is rendered evident by recalling the veins of the diploe, and by a reference to Fig. 3, which shows the connection between the veins of the sphenoidal mucosa and those of the cavernous and circular sinuses, and the ophthalmic vein.

The roof of the sphenoidal sinus may be only 1 to 2 mm. thick, and Zuckerkandl has found physiological defects in the bony wall, placing the mucosa of the sinus in direct contact with the dura. He has found similar dehiscences, placing the sheath of the cavernous sinus and the mucous lining of the sphenoidal cavity in contact.

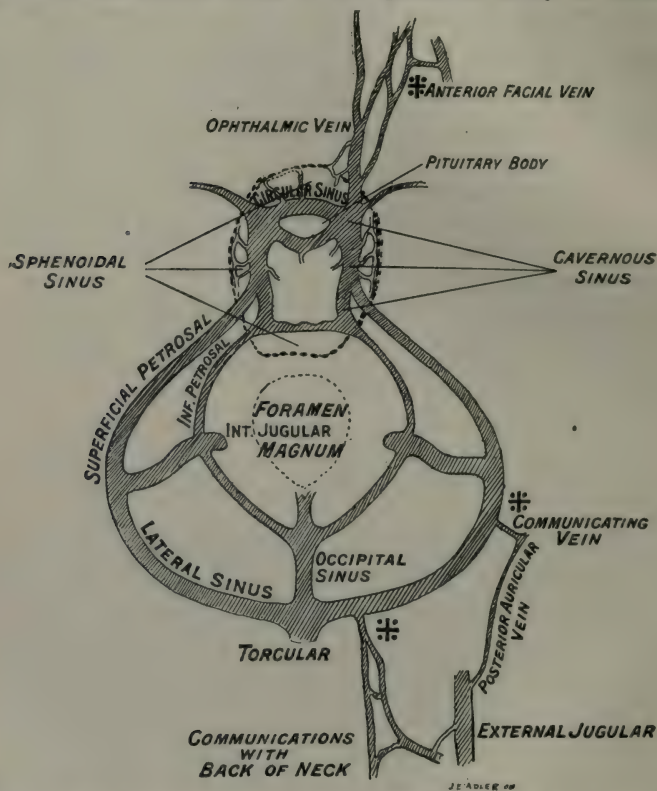


FIG. 3.—Diagram to show Communication of Veins of Cavernous Sinus with Venous Sinuses of the Cranium; showing also inter-relation of Transverse and Cavernous Sinus with external Veins. The asterisks (*) mark the anastomoses of the intra-cranial venous system with the veins of the surface. (Modified from Leube.)

Here the wall is thin as note paper, and Siéur and Jacob* have found numerous vessels running through it from the sphenoidal to the cavernous sinus (*vide* Fig. 3). These defects in the roof of the tympanum have been much more studied than similar anomalies in the nose.

* 'Les Fosses Nasales et leurs Sinus.' Paris, 1901.

In some cases prolongations of the sphenoidal sinus may reach as far as the pterygoid process, and the pus may filter across the pterygo-maxillary fossa, reach the zygomatic fossa, and even point at the level of the first large molar tooth. Moreau, who points this out, makes the suggestion that in this way a swollen face, or a gum-boil, may be an early symptom of a sphenoidal sinusitis spreading beyond its boundaries.

(c) *By the Lymphatics.*—But the above venous channel, although it would explain the route in my case of thrombosis, would be less satisfactorily invoked in the case of meningitis. To explain the route of infection in such cases, the lymphatics have been considered as possible channels—based chiefly on the works of Key and Retzius,* and the later investigations of Cunéo and André.† The lymphatics of this region communicate with those of the endo-cranium, and also with the peri-pharyngeal ganglia. Hence the possibility of a sphenoidal empyema being caused by an infectious angina. (Compare Cases 3, 11, 18, 26.)

In Zörkendörfer's case (No. 4) the pneumococci of Fränkel-Weichselbaum were found in the meningeal pus, and in the pus of the sphenoidal sinuses. But they were not found in the blood, nor in the heaps of leucocytes within the blood-vessels, nor in the substance of the brain. From this it is concluded that the penetration of the diplococci did not follow the blood stream, but passed by the lymph stream, or direct through the tissues, although the latter showed no change to the naked eye.

Grünwald is of opinion that the exudation in his case (No. 42), lying between the mucous lining and the bony wall of the sphenoidal sinus, showed that the infection must have spread by way of the lymphatics and without disease of the bone.

Leaving, now, this question as to the channels of infection between the sphenoidal sinus and the endo-cranium, I would call attention to the general absence of intra-cerebral abscess. In Sandford's case (No. 38) it is not clear if the "intra-cranial" abscess was extra- or intra-dural. In Grünwald's Case (No. 42) the greenish-yellow masses appear to have originated from exudation in the lateral ventricle.

* 'Stud. über d. Anat. d. Nervensyst., &c.,' Stockholm, 1875.

† 'Contributions à l'étude des Lymphatiques du Nez et des Fosses Nasales,' Paris, Stienheil, 1905; 'Annales des maladies de l'Oreille,' Tome xxxi, No. 5, Mai, 1905.

Sinus thrombosis attacks chiefly the cavernous sinus, spreading *viâ* the circular sinus to that of the opposite side, as well as forwards to the ophthalmic vein, and sideways to the petrosal sinuses.

Summary of Pathogenesis.—The following is an epitome of the above considerations:—

1. Infection of the cranial cavity depends largely on the virulence of the infective organism, and the diminished resistance of the individual.
2. Neither the long duration, nor the extent of pathological changes in the sphenoidal sinus, appear to be prime factors in this extension.
3. Infection of the cranial cavity takes place through the perforation of the bony walls, through the bone diploe, through the veins, or by the lymphatics.
4. Thrombosis of the cavernous sinus, and basal meningitis, are the commonest consequences and occur with equal frequency.
5. Other complications are much less frequent. (*Vide* list on p. 11.)

PROGNOSIS.

These cases illustrate the grave complications which may arise in a patient who complains of nothing, or, at most, nothing more than post-nasal catarrh. Even if it is diagnosed that this "catarrh" originates in the sphenoidal sinus, we are at present loth to recommend operative measures in the absence of much discomfort. Data are wanting to show the mortality of this form of empyema. Yet, as we have seen, alarming, and possibly incurable, complications may suddenly arise. In future we cannot tell a patient with sphenoidal sinusitis that there is no harm in leaving it alone. Pus in this cavity apparently is fraught with more danger than in any of the other pneumatic spaces of the skull. Its anatomical relations are most delicate and intimate. It resembles the mastoid antrum in not having its ostium at a dependent point, but it is much more inaccessible, and the onset of secondary complications is far less definite. The maxillary sinus is rarely the originator of cerebral lesions, and there is no excuse for not treating this cavity as soon as pus is found in it. The frontal sinus possesses the great advantage of having its ostium at the most dependent point, and by freeing the access to this point we facilitate drainage and lessen the risk to

the cranial contents. It seems to me that suppuration in the sphenoidal sinus should never be left untreated. The opening in the anterior wall can be enlarged, and suitable measures will often result in completely curing the discharge. If not entirely arrested, the establishment of a free communication with the nose will relieve the patient of many symptoms, and will diminish the risks, otherwise inseparable, from fresh infection of the cavity.

In early cases of relapsing cyclitis, in choroiditis, and even in early glaucoma, Ziem claims that treatment of the causative or contributory nasal suppuration will cure, or contribute to recovery.

Ophthalmic changes induced by sphenoidal sinus disease may be cured, if the infection has not spread by the cavernous sinus or ophthalmic vein. In a case of sudden, unilateral blindness, produced by exudation into the optic sheath, the eyesight has been restored by opening and draining the sphenoidal sinus.*

In a remarkable case recorded by C. R. Holmes, there was total loss of sight in one eye from retro-bulbar inflammation. Although no pus could be seen by anterior or posterior rhinoscopy, and although the patient when questioned denied any annoyance from nasal catarrh, yet the sphenoidal sinus was opened; thick creamy pus was evacuated and vision was restored.† In both these cases there was some exophthalmos, and the eyeball was tender.

When the meninges are affected, it is suggested by Stanley Barnes (Case 16) that if a lumbar puncture withdraws a thick or yellow fluid, operation would be useless. But that, if the cerebro-spinal fluid is only slightly turbid, an operation would not be contra-indicated. He thinks Kernig's symptom is uncertain, and that stiffness of the neck may be present in these cases without meningitis (as it was in my case, No. 21).

Even early operation on the sphenoidal sinus, as in the case of Flatau (No. 7), fails to arrest a meningitis, and in my case of thrombosis the free and continued drainage of the original source of infection produced no visible benefit. In three other cases, operation on the sphenoidal sinus gave no relief (Nos. 28, 34, 40). In Bronner's case (No. 20), the injection of antistreptococcic serum appeared, if anything, to make the patient worse; though it is fair to remember that the pathogenic organism had not been recognised.

Suppurative meningitis appears at present to be beyond surgical

* T. W. Halsted, 'Archives of Otolaryngology,' vol. xxx, 1901, p. 222.

† 'Archives of Ophthalmology,' vol. xxv, 1896, p. 460.

skill; but in cases of early threatening meningeal invasion I should in future be inclined to freely open and disinfect any suppurating sphenoidal cavity. The ease with which this could be done, and the facility with which after treatment was carried out, was noticeable in one of my cases (Case 21).*

OPERATION ON THE CAVERNOUS SINUS.

With regard to the possibility of operation when only the cavernous sinus is involved, Dr. Dwight, in one case, attempted operation by approaching it through the temporal bone, by the route recommended by Krause in his operation for intra-cranial resection of the trigeminus. He succeeded in opening the sinus but the patient died six and a half hours after the operation.

In the 'Centralblatt für Chirurgie,' 1893, No. 22, there is the record of a case in which Bircher approached the region by trephining above the external auditory meatus, resecting all the pyramid except the inferior wall of the carotid canal, and dividing the facial nerve. Before the operation there were signs of paralysis of the third, fourth, and sixth pairs, with immobility of the eyeball. The patient recovered, with complete facial paralysis and limited movement of the eyeball. Luc suggests that the lesion in this case may have been a small extra-dural abscess and not a cavernous thrombo-phlebitis, and that, in any case, the route of operation is not one to be recommended.

The route followed by Voss† was through the base of the great wing of the sphenoid, making an osteo-plastic flap to include the temporarily detached zygomatic-malar arch. The Gasserian ganglion was first exposed, and the sinus was found on its inner side. He opened it by an incision 6 centimetres long; but the patient succumbed to meningitis.

But if approached from its cerebral surface the cavernous sinus is opened through the wall where the most important structures are situated (Fig. 4). Grünert‡ therefore suggested that the best route was *viâ* the nose and the sphenoidal sinus, and this idea had

* E. A. Crockett, in the 'Boston Medical and Surgical Journal,' January 25th, 1906, publishes a case of meningitis successfully treated by drainage of the subdural space. The infection was from the ear.

† 'Centralblatt für Chirurgie,' No. 47, November 22nd, 1902, p. 1201.

‡ 'Die operative Ausräumung des Bulbus Venæ Jugularis, in Fällen otogener Pyämie,' Leipzig, Vogel, 1904.

independently occurred to Luc,* who has shown that it can be satisfactorily carried out on the cadaver, with good prospect of its success in the living subject. He approached the sphenoidal sinus by first traversing the maxillary sinus from the canine fossa. An important point of his researches is that although he always succeeded in making a large opening into the sphenoidal cavity, he was never able to break through its lateral wall into the cavernous sinus—if he had approached it by the maxillary cavity on the same side. It was, in fact, impossible to apply the chisel perpendicularly to the lateral wall of the sphenoidal cavity, and



FIG. 4 (semi-diagrammatic).—Coronal Section, through Sphenoidal Sinus, to illustrate immediate relationships with cavernous sinus and its contents, optic nerve, and base of brain.

each attempt resulted in its entering the cranial cavity, either at the posterior extremity of the cribriform plate or beside the anterior clinoid process. However, on approaching the sphenoidal sinus by traversing the maxillary cavity of the *opposite* side, he succeeded in every instance in opening the side of the sella turcica and penetrating the cavernous sinus, without injuring the nerve trunks lodged in its outer wall, the sixth nerve, or the carotid. The latter artery is slightly above the wall attacked, and does not run the risks to which it is exposed when the cavernous sinus is approached from the endo-cranial surface.

If the ophthalmic vein is already thrombosed, or if the infection originated from the orbit, it will in addition be necessary to open

* 'Annales des mal. de l'Oreille,' vol. xxi, June, 1905, No. 6, p. 521.

the orbital cavity by the route suggested by Krönlein. The zygomatic border is temporarily resected, so as to allow of removal of the deeper part of the external orbital wall, and thus permit of access to the summit of the orbit, where the ophthalmic vein and its principal afferent branches are reached.

If the patient's life is to be saved by operation it must be by undertaking measures before the septic phlebitis has extended beyond one cavernous sinus—an extension generally indicated by the development of ophthalmic symptoms on the opposite side. Perhaps the above suggestions may prove helpful to those who are called on to treat this grave complication.

TREATMENT.

I think that at present our knowledge justifies us in advising any patient with pus in a sphenoidal cavity to have the orifice of it enlarged, and the sinus drained and treated, both for the relief or cure of the suppuration, and as a preventive of intra-cranial complications. Fortunately, this can be done without external operation, and with less serious risks than attend operation on the frontal sinus. The Röntgen rays promise to help us materially both in diagnosis and treatment (Fig. 5).

The treatment of these accessory nasal cavities is a delicate matter, and the above record suggests that the rhinologist is not necessarily responsible for the fatal intra-cranial complications which may arise. Secondary infections may be precipitated by surgical traumatism, but, also, they may simply be coincident.

CONCLUSION.

In conclusion, if the association of sphenoidal sinusitis with disease in the orbital and cranial cavities has not been hitherto more fully substantiated, this is partly due to the fact that neither physicians nor surgeons attach much importance to the condition of the nasal cavities, either at the bedside or on the *post-mortem* table.

Records not infrequently appear in our journals of cases in which physicians express surprise at meeting with a case of apparently primary meningitis. Or we read of a surgeon trephining a skull for symptoms of "cerebral compression," and at the *post-mortem* he expresses his astonishment on discovering suppurative basal meningitis, which he is unable to track through the bone to the middle ear or elsewhere.

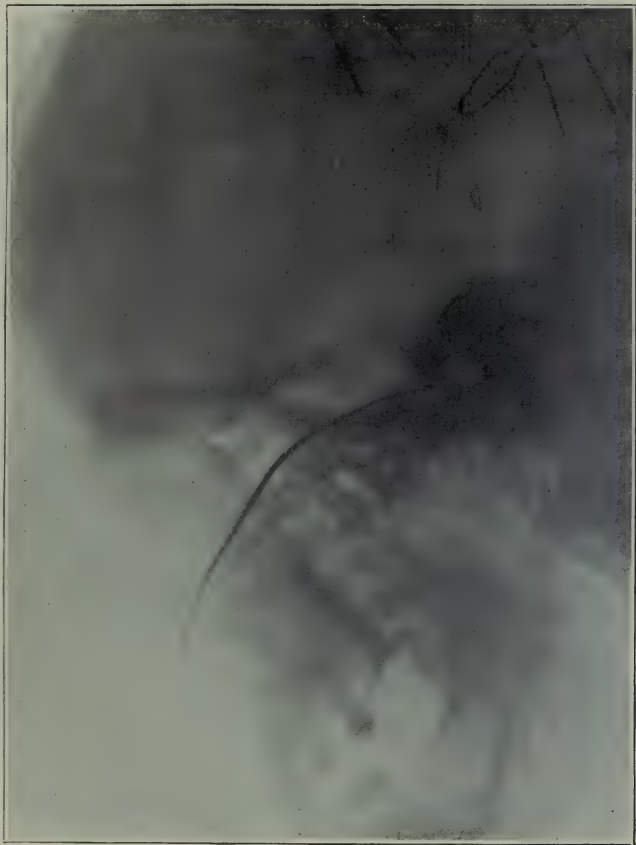


FIG. 5.—Probe in Left Sphenoidal Sinus; Rubber Plug in Left Maxillary Sinus. Both frontal sinuses have been operated and both ethmoidal cells.
(Radiograph by Mr. A. D. Reid.)

Another reason why this association is overlooked is that patients will frequently attend a rhinologist, or a throat clinic, when their nasal suppuration or their upper air passages cause them discomfort, but when complications supervene they are apt to go elsewhere and give no history of their nose or throat trouble.

I hope that, in view of my findings, pathologists will more regularly carry the *post-mortem* examination through to the neighbouring pneumatic spaces of the nose. No *post-mortem* examination is really complete without an investigation of the nose and its accessory sinuses.

I venture to urge that in cases of headache and neuralgia, in intra-cranial inflammation, in the presence of thrombosis of the ophthalmic vein or cavernous sinus, the nose and its accessory sinuses should be examined as regularly as are the ear and the eye, and that in all cases of apparently inexplicable retinitis, papillitis, and optic atrophy the nose requires exploration.

It is only by the collection of a large number of data, clinical and *post-mortem*, that we will learn how often these sinuses are diseased, and which are the most frequently affected.

I look forward to our thus securing much valuable information in regard to the association of nasal suppuration with diseases of the eye and the brain, as well as with more distant parts.

APPENDIX.

BIBLIOGRAPHY OF 42 CASES OF CEREBRAL AND OPHTHALMIC
COMPLICATIONS OF SPHENOIDAL SINUSITIS.

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THROMBOSIS.

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MENINGITIS (17 Cases).

CASE 1 (Horner, "Periostitis orbitæ und Perineuritis nervi optici," 'Klinische Monatsblätter für Ohrenheilkunde,' vol. i, 1863, S. 71).—Female, aged 15. Headache, swelling of right sub-maxillary glands. Three months later, after three days of violent headache, sudden blindness in right eye.

On admission—right exophthalmos and limitation of movements of eyeball; optic disc cloudy and not sharply defined, small arteries, broad veins; lids not swollen; no fever; absolute amaurosis; pressure on border of eyeball not painful, but pain on pressing eyeball backwards. Two months later, acute headache, restless, pulse 64. Three days later, coma, no paralysis, but complete unconsciousness. Two days of fever (37.6°C.), pulse 120, and then death.

Post-mortem.—Brain substance normal; meningitis; basis of sphenoid carious, periosteum thickened and dark red; some changes in both wings, but particularly right, the floor of the sella turcica, and the posterior plane; in the right foramen opticum the disorganisation was most marked and fresh pus present.

CASE 2 (Demarquay, quoted in Morell Mackenzie's 'Diseases of the Throat and Nose,' vol. ii, p. 370 (London, 1884); Berger and Tyrman, p. 19; also in Grünwald's 'Nasal Suppuration,' p. 140).—Male, aged 74. Twenty-one months before death a frontal empyema was found to be present after an operation for the avulsion of polypi. The abscess in the frontal sinus healed after trephining. Polypus recurred. A year later, facial erysipelas. After six months, another relapse of polypi. Roots painted with strong nitrate of silver; followed by sharp headache on right side. Twelve days later, marked swelling of right lower eyelid, right eye immovable, pupil dilated, no reaction to light. Death 14 days later.

Post-mortem.—Right-sided, basic, meningeal congestion. Body of sphenoid brittle, with pus oozing through the sella turcica. The cavernous sinus was bathed in pus. The pituitary membrane on the right side was infiltrated with pus. The sphenoid, ethmoid, and maxillary sinuses were full of pus.

CASE 3 (Weichselbaum, quoted by Netter in 'Archives Générales de Médecine, 1887, vol. i, p. 454).—Man, aged 21. Admitted for

tetanus. Temperature 39.7° C. (103.4° F.). Pain in extremities, stiffness of neck, left facial paralysis, then redness of right cheek, vomiting, tetanic attacks. Ptosis and mydriasis right. The redness extended to the inferior eyelid and nose. Death on the seventh day.

Post-mortem.—Pia mater injected, chiefly left. Anterior basic meningitis. Brain healthy. Pus in the maxillary sinuses, and opaque, yellow plaques in the tympanic, frontal, and sphenoidal cavities—in the right there were five plaques and two in the left. The tonsils were soft and infiltrated with pus. Double pleurisy and patches of broncho-pneumonia in right lung.

(Commenting on this case, Netter regards it as an example of meningitis after fibrous inflammation of the sinuses. The characters of the inflammation in both situations are those caused by the pneumococcus, which had also attacked the lung. He thinks there are two groups of pneumococcic meningitis—from metastasis and from direct infection.)

CASE 4 (Zörkendörfer, 'Prager med. Wochenschrift,' vol. xviii, Mai 3, 1893, No. 18, p. 209).—Woman, aged 30. Brought comatose to clinic on March 18th. Only history was that she had been ill for two days with rigors and pain in chest. High fever, 39.6° C. Normal in chest and abdomen. Urine contained albumen. In the night of the 18th, quite unconscious, with stiffness of back of neck, paresis of the right facial nerve, and abdomen painful to the touch. In the urine deposit there were hyaline cylinders with fat cells and a few leucocytes. Next day fever, 40.6° C. In the evening, deviation of the orbit upwards and somewhat outwards. Next day continued high fever, stupor, and death.

The diagnosis was suppurative meningitis, possibly of septic abdominal origin. The existence of chronic nephritis was also suggested.

Post-mortem.—Suppurative meningitis. Nothing in brain. Sinuses opened by Harke's method;* showed softening and redness of mucosa of the nose and ethmoid cells, while the mucous membrane of the sphenoidal sinuses showed marked, dull redness, and was covered with thick, green-yellow pus. On the somewhat reddened pharynx a very thin layer of pus rested. In other organs only

* 'Virchow's Archiv,' 125, 1891.

parenchymatous degeneration. In the apices, small, old, tubercular lesions. Smears of the meningeal pus and of the pus of the sphenoidal cavities showed more or less numerous diplococci, which both in appearance and staining reactions proved to be the pneumococci of Fränkel-Weichselbaum.

They were not found in the blood nor in the heaps of leucocytes within the blood-vessels, nor in the substance of the brain.

From this it is concluded that the penetration of the diplococci did not follow the blood stream, since the large leucocyte masses in the blood-vessels were free of bacteria, while the exudate of the meninges was richly infiltrated with diplococci. They entered by the lymph stream or direct through the tissue, although the latter showed no change to the naked eye.

Cultures were characteristic. The organism killed a rabbit in 20 hours, with typical septicæmia.

CASE 5 (Pekostawski, ref. in 'Centralblatt für Laryngologie,' vol. x, December, 1893, p. 288).—*Post-mortem* is a case of purulent meningitis. Suppuration in sphenoidal sinus. Ulceration of upper part of vomer. Thrombosis of longitudinal sinus. Softening of sella turcica.

CASE 6 (Dmochowski, 'Archiv. für Laryngologie,' Band III, 1895, pp. 255 and 301).—Male, aged 51. A *post-mortem* on a case diagnosed as croupous pneumonia with phlegmon of neck and face. Acute purulent rhinitis on right side, with sphenoidal and maxillary sinusitis on the same side. Numerous bony perforations (caries of sphenoid, superior maxilla, and temporal). Retro-orbital abscess. Phlegmon of face and forehead. Suppurative meningitis. Intradural abscess and abscess of right frontal lobe.

Suppurative meningitis most marked at base. In the anterior part of the right frontal lobe an abscess, size of a walnut, with smooth walls. The abscess contained yellow-green, not offensive, very viscid pus. The dura on right side of sella turcica thickened, infiltrated with pus, and perforated (intradural abscess). The opening, size of a pea, lead into sphenoidal sinus, which was filled with pus similar to that found in the brain abscess.

Phlegmon of right face and forehead. Retro-orbital abscess, with opening in floor, size of a pea, leading into maxillary sinus. Bones round orbit carious and infiltrated with pus.

Acute purulent rhinitis on right side. The right maxillary sinus

filled with thick, fluid, viscous, not offensive pus. Caries of the walls and an opening leading into the sphenoidal sinus, as well as the one communicating with the orbit. The frontal and ethmoidal sinuses were healthy. Pneumonia right base.

Bacteriological examination of pus in brain and nose showed various organisms, but none of the recognised forms.

CASE 7 (Flatau, 'Berliner klin. Wochenschrift.,' vol. xxxii, No. 41, 14 October, 1895, p. 901).—Young girl with bilateral sphenoidal sinusitis. The chief symptoms were intense headache and a change in her mental condition with tearfulness and absent-mindedness. The sphenoidal sinus was opened on each side. There was no improvement in headache or vertigo; she became somnolent and died in two days.

The *post-mortem* revealed meningitis through spontaneous rupture of the sphenoidal empyema, and that this had been latent some time. The left sinus appeared enlarged, the walls were thinned, and the perforation was in the outermost corner to the left, behind and somewhat above.

CASE 8 (Caudet and Druault, 'Annales des maladies de l'Oreille,' vol. xxv, ii, 1899, No. 8, p. 211).—Female, aged 24. Good health generally. For some years headache and facial neuralgia. After a cold, attacked with shiverings and pain on right side of head and right orbit.

Admitted to hospital at end of a fortnight with temperature of 41.5° C. (106.6° F.) rigors, violent pain in right side of head and orbit, and commencing swelling of right eyelids, chemosis, exophthalmos. Pupil more dilated than on right side; movements of eye limited and painful; vision diminished; vomiting; delirium; coma; and death four days after admission. The nasal fossæ were not examined. An incision had been made below orbit, two days before death, giving exit to a drop of pus. A few hours after death a bacteriological examination was made from this wound and cocci and chains of streptococci were discovered.

Post-mortem.—Purulent basic meningitis, chiefly limited to right side and the sella turcica. At this point the dura mater was easily detached and revealed a round orifice (3 to 4 mm. in diameter) opening into the left sphenoidal sinus. The left sphenoidal, ethmoidal, and maxillary cavities were full of slightly foetid, blackish pus, and the mucosa lining them was thickened and

friable. The left frontal and the right sphenoidal were full of clear mucus.

There was phlegmon of the right orbit without purulent collections, not apparently connected with the meningeal lesions except by the ophthalmic vein.

The upper teeth on the right side were sound. On the left side the only one diseased was the first molar, which was almost entirely destroyed by caries.

(*Note by StC. T.*—There is no mention of the condition of the cavernous sinus, although it is suggested that the right orbit was invaded secondary to the meninges, through the cavernous sinus and the ophthalmic vein. It is noteworthy that the suppuration commencing in the accessory sinuses of the left side of the nose spread to the meninges and orbit on the right side, through the sphenoidal sinus. The septum between the two sphenoidal sinuses was deviated to the right, and the carious opening was in the centre of the anterior wall of the sella turcica.)

CASE 9 (Grünwald, 'Nasal Suppuration,' English Edition, London, 1900, p. 137).—Mention of a case of basilar meningitis, only seen *post-mortem*, and caused by spontaneous perforation of a sphenoidal empyema into the middle cerebral fossa.

CASE 10 (Samuel Lodge, Jr. 'The Laryngoscope,' March, 1900, vol. viii, No. 3, p. 139).—Man, aged 31, with clear history of syphilis nine years previously.

Admitted for constant pain in right ear and right side of face, of six months' duration. For two months the right side of face had been swollen. Copious discharge of matter from right nostril. Temperature 100° F. Skin over right maxilla red and oedematous; teeth in fair condition. Thick pus in right nostril from superior meatus. Right maxillary antrum punctured and found clear. Nothing abnormal in ears. Urine, trace of albumin. Patient treated with iodide of potassium and inunctions and improved at first; but he became drowsy and comatose and died 24 days after admission.

Post-mortem.—Thick, greenish purulent basic meningitis, principally in neighbourhood of pituitary body. No brain abscess. Frontal and ethmoidal cavities normal. To right of sella turcica some necrosis of walls of sphenoidal sinus, and probe readily passed from base of skull through sphenoidal sinus into nose. The sinus

was full of thick muco-pus. Right maxillary antrum contained a drachm of thick glairy mucus. No thrombosis of cavernous sinus.

CASE 11 (Toubert, 'Archives Générales de Médecine,' vol. clxxxvi, 1900, p. 385).—Male, aged 22. Admitted for influenzal bronchitis. Well at end of 12 days; then suffered from tonsillitis, and afterwards appeared well, when, a month from date of admission he was seized with agonizing pain in left eye and an acute otitis. Incision of drum evacuated serous liquid and gave relief. Recovery, and relief till a month later, when he was attacked with intense headache, repeated rigors, temperature of 40.3° C., vomiting. Suspicion of typhoid fever was negatived on further examination, and that of meningitis was adopted, although the cause could not be determined in the ear or the bone. Anterior and posterior rhinoscopy were carried out with care, and no suspicion of sphenoidal disease was suggested. Death at end of 14 days from beginning of last attack.

Post-mortem.—Thoracic and abdominal organs healthy. Suppurative basic meningitis, containing unmixed streptococci. Left middle ear full of dirty-green yellow pus. Antrum small and filled with gelatinous exudate; tegmen intact. Lateral sinus healthy. No phlebitis of the cavernous sinus; no osteitis of temporal fossa or cerebral surface of sphenoid. Bony walls of sphenoid friable; bilateral sphenoidal suppuration yielding streptococci in pure culture. Mucous lining purple-red. The ethmoidal, frontal, and maxillary cavities all healthy.

CASE 12 (Toubert, 'Archives Générales de Médecine,' vol. clxxxvi, 1900, p. 385).—Male, adult. Complained one morning of fatigue, and went to his room to rest. Was found unconscious at 4 the same afternoon.

On admission, was in complete coma. No paralysis or contractions. Right pupil more dilated than the left; but reacted to light. No strabismus or exophthalmos. No vomiting. Temperature, 39° C. Lumbar puncture withdrew a purulent liquid containing micrococci in pairs of diplococci. Death at end of four days.

Post-mortem.—Abdominal organs healthy. Some centres of broncho-pneumonia. Diffuse meningitis, concentrated chiefly over the right Sylvian artery and the upper surface of the cerebellum. No thrombosis of cavernous or other venous sinuses, and no osteitis in the base of the skull. Body of sphenoid bone was hard. The

left sphenoidal sinus was healthy ; the right held 2 c.c. of sulphur-yellow, fluid pus, containing micrococci grouped in diplococci or in chains. The mucosa of both sinuses was healthy, but that of the right was pinker. The ethmoidal, frontal, and maxillary cavities were healthy, and there was no pus in the nose.

CASE 13 (Toubert, 'Archives Générales de Médecine,' vol. clxxxvi, 1900, p. 385).—Condition found *post-mortem*, during anatomical researches, by Sieur and Jacob).—Female, aged 60 to 65. Basic, non-suppurative meningitis, most marked on the right side, and extending along the fissure of Sylvius. No phlebitis of venous sinuses. Nothing abnormal in base of skull. Sphenoid bone healthy. Right sphenoidal sinus filled with thick muco-pus ; the mucosa was thick, red, and in parts almost ecchymotic. The ostium was open. The left sphenoidal sinus contained no pus, although its mucosa was congested.

CASE 14 (Oscar Dodd, 'The Laryngoscope,' x, 1901, No. 5, p. 334).—Male, aged 29, suffered from catarrh at intervals for one and a half years. Ten days before admission severe pain in right ear, relieved by pus and hæmorrhage. Pain recurred and nearly "drove him crazy."

On examination, very irritable. Muco-pus evidently coming from some of the accessory sinuses, but patient would not permit thorough exploration. Pus from small perforation in right membrana tympani ; no swelling or tenderness over mastoid. Severe pain complained of in the ear and back of the head. Temperature 101.8° to 103° F. As pain continued over right eye and ear, the mastoid was opened. Cells were found healthy, except for small pus cavity near tip. The antrum was not opened. Followed by relief for five days. No trouble with optic nerves or ocular muscles. Then seized with vomiting, deviation of right eye, and inequality of pupils. Temperature 104° to 105° F. Delirium. Wound re-opened and no pus in middle ear or antrum. Optic nerves congested and veins engorged, but no swelling of the nature of a choked disc.

Seen by the rhinologist who had treated him at intervals for a year for a nasal trouble, but had never seen any sign of trouble with the sphenoidal sinus. Death occurred four days later, *i.e.*, about 16 days after first complaining of his ear.

Post-mortem.—No trouble in region of temporal bone. Purulent basic meningitis. Body of sphenoid so fragile that it broke easily, showing a large cavity filled with pus. The walls had become so

thinned that they broke like an egg-shell, so that it was impossible to say if there had been a perforation into the cranial cavity.

Case evidently one of sphenoidal sinusitis of long standing, as it was found afterwards he often had similar severe attacks of pain, subsiding under treatment.

CASE 15 (C. E. Beevor and E. Farquhar Buzzard. Case of basal meningitis due to streptothrix infection. 'Transactions, Pathological Society of London,' vol. liv, 1903, p. 321).—Female, aged 37, admitted for headache and vomiting. Previous health good, except for epileptic fits since age of 10. Three weeks before admission severe attacks of vomiting irrespective of food, followed by headache, pain, and stiffness in back of neck, failing sight, slight dysphagia, and husky speech.

On admission severe pain in head, especially behind the right mastoid. No optic neuritis. Vision $\frac{6}{6}$. Ptosis of left eyelid, and limitation of all movement of the left eye. Movements of right eye outwards defective, with coarse nystagmoid conjugate movements in all directions, but especially to the right. Diplopia in looking up and down and to the left. Pupils equal and reacting to light and accommodation, but the left dilating again quickly.

Irregular temperature from 98.4° to 103.4° , and rising to 105° at the end.

Three days after admission she passed into a condition of stupor, with some retraction of the head. No fits. Coma. Death 15 days after admission and five weeks from onset of illness.

Post-mortem.—Well-marked suppurative basic meningitis, limited sharply to the left side. In dissecting the periosteum off the body of the sphenoid the latter was found to be quite rotten, from the sella turcica backwards so as to involve the greater part of the basilar process of the occiput. No suppuration in association with the middle ears or their neighbourhood. Maxillary antra and dental sockets examined, with negative result. Internal viscera healthy.

Smears of pus from the base of the brain revealed the presence of an abundant streptothricial organism in the form of mycelial filaments, sometimes collected into entangled tufts and sometimes scattered about singly or only two or three together. No clubs or rosettes were to be seen. No growth was obtainable from several cultures.

CASE 16 (Stanley Barnes, "Septic Meningitis Secondary to Disease of the Nose" (from the clinic of Dr. Foxwell), 'Birmingham Medical Review,' September, 1905, p. 533).—Male, aged 26, had a nasal polypus at age of 12. Was treated intermittently for polypus, and had several "operations" on his nose (apparently chiefly cauterisation) up to 14 months before admission. Subject all his life to bilious attacks, with headache and sickness.

Admitted for headache, giddiness, and pain in back of neck during previous 11 days. Conscious, but sleepy. Pupils large but reacted. Optic discs congested, but not swollen or blurred. No ocular paralysis or nystagmus. Neck held rigid, and any movement very painful. No definite paralysis. Kernig's sign well marked. Right tympanic membrane thickened, no pus; left, normal. Temperature 103° . Pulse 104. No special examination of the nose was made. Operation behind right ear, exposing dura mater over lateral sinus, middle fossa, and cerebellum; no pus found, and no thrombosis. Patient died next day—*i.e.*, two days after admission, and 13 days from onset of giddiness.

Post-mortem.—Large collection of pus at base of brain, tracking down under the arachnoid to the cauda equina. No abscess in the brain substance. Yellow pus in both cavernous sinuses, petrous sinuses, Sylvian veins, and pterygoid plexuses of veins. Superior longitudinal and both lateral sinuses filled with anchovy sauce-like material, containing many organisms.

Upper surface of basi-sphenoid was bare, eroded, and bathed in pus. Sphenoidal sinuses contained much muco-pus. Ethmoidal, frontal, and maxillary sinuses full of muco-pus. Two large mucous polypi attached to middle turbinals.

The pus from the base of the brain, the veins of the pterygoid plexus, the frontal and maxillary sinuses, the pus bathing the polypi, and the above-mentioned venous sinuses, yielded pure cultures and streptococci. In a few cases an odd growth of staphylococci (probably accidental) occurred in addition.

CASE 17 (StClair Thomson, *vide* my first case, p. 3).

THROMBOSIS (4 cases).

CASE 18 (Ortmann, 'Virchow's Archiv. für pathol. Anat. u. Phys.' Band 120. 1890, p. 117).—Female, aged 13. Sudden shivering, with headache, coryza, and conjunctivitis. Swollen

eyelids. Admitted with diagnosis of angina simulating diphtheria. Some opisthotonos and trismus. The eyelids were swollen; chemosis. Pupils small and not reacting. Temperature raised. Diagnosis altered to meningitis. Death on the fifth day.

Post-mortem.—In the upper and posterior portion of the nose abundant, purulent secretion; the mucous membrane red and swollen. The frontal, maxillary, ethmoidal, and tympanic cavities contained no pus, and the mucosa not visibly altered. Both middle ears were normal. But both sphenoidal sinuses were full of pus, and floating in each of them was a small sac of pus—the detached mucous lining. Brain not altered. Dura mater over sella turcica red brown. On raising this, a sub-dural abscess. The sphenoid bone was dirty yellow, not perforated. There was purulent thrombosis in each cavernous sinus. Slight basic meningitis. Swelling of post-nasal mucosa. No suggestion of diphtheria, and in the internal organs no visible change from the normal.

Typical, virulent diplococci pneumoniæ were found in the nose, sphenoidal sinus, and the meninges. Micrococci and encapsuled cocci were also found in the pus of the nose and the sphenoidal sinuses. The diplococci were also found in the sphenoid bone itself, so that the infection had taken place by direct continuity. The recent catarrh of naso-pharynx had led to retention, or was itself a pneumococcal infection.

CASE 19 (C. E. Finlay, 'Archives of Otology,' vol. xxxii, No. 6, 1903, p. 419).—Male, aged 16. History of purulent discharge from left ear for several weeks. Two days before admission intense pain left ear, with temperature of 104° F. The left drum was punctured and a profuse discharge started. Next day it diminished, pain and fever returned, and diplopia and delirium set in.

On admission the patient was delirious, unconscious, semi-comatose. Temperature 104° F., pulse 120, irregular and intermittent. Left ear: Small perforation, with small amount of pus. Eyes: Paralysis of left external rectus; papillary reaction normal; fundi normal. Swelling parallel to and a little below left superior orbital margin.

Diagnosis: Sinus phlebitis, or cerebral abscess.

Operation: Only a minute amount of pus found in the antrum and middle ear. Tegmen tympani, lateral sinus, temporal fossa, and dura mater all found normal. Puncture of brain negative.

Patient died next morning.

Post-mortem.—No pus in middle ear, antrum, or temporal bone. No sign of brain abscess. Lateral sinus normal. Plastic exudation at base of brain. Cavernous and circular sinuses occupied by a purulent clot, which extended into the left ophthalmic vein. The sphenoidal and posterior ethmoidal cells were occupied by a thick, yellow, foetid pus.

Inquiry showed that patient had never complained or shown any evidence of nose trouble.

CASE 20 (A. Bronner, 'Brit. Med. Jour.,' November 12th, 1904).—Female, adolescent. Anæmia for years. Never much discharge from nose, and on careful inspection absolutely no subjective or objective symptoms of disease of the sphenoidal sinus. Illness commenced with severe headache. Five days later swelling right eyelids, proptosis, chemosis, limited movements, no strabismus. Fundus normal; no papillitis or congestion of veins. Temperature 101° F. Left eye developed similar condition six days later. No redness. Rigors. Perspirations. Temperature rose to 106° F. Vision remained good, and there was no papillitis, but retinal veins became congested. No retinal hæmorrhages. Ulcer on cornea. Headache. Drowsy. Death 31 days from commencement of ophthalmic symptoms.

Post-mortem.—Both cavernous sinuses thrombosed and filled with pus. The left lateral sinus gangrenous, and the left petrosal sinus full of pus; the longitudinal sinus thickened and filled with large red clot. Some pus at apex of both orbits. Both sphenoidal sinuses full of pus and granulation tissue; the septa practically destroyed. The ethmoidal and frontal sinuses apparently not affected.

CASE 21 (StClair Thomson, *vide* my second case, p. 5).

THROMBOSIS AND MENINGITIS (13 Cases).

CASE 22 (Scholz, 'Berliner klin. Woch.,' 21 October, 1872, No. 43, p. 516).—Man, aged 21, had complained of his throat for six months. Suddenly seized with rigor, delirium and fever and admitted with diagnosis of "delirium tremens."

On admission, delirious and difficult to keep in bed. Extensive phlegmon of right side of face and neck. Incisions made at outer edge of orbit, over the temporal bone; the cheek and the sub-meatal region gave exit to a considerable amount of offensive pus, but with

only slight relief. Pus was also let out in the mouth on the right side, behind the last upper tooth. The probe detected nothing amiss with the bone. Temperature irregular, from normal to 41° C. (106° F.) Rigors. Left-sided ptosis. Coma. Death on the twelfth day from sudden hæmorrhage from the mouth and nose, and suffocation.

Post-mortem.—Caries of the body of the sphenoid, so that the right sinus communicated direct with the right cavernous sinus. The carious process also extended from the body of the sphenoid to the right pterygoid process, which was rough, and bare of periosteum. The right half of the face, as high as the zygoma and down towards the larynx, was infiltrated with serum and pus. The sphenoidal sinus contained a small amount of pus, and its lining was injected and swollen.

Basic meningitis, spreading up to the convexity. Intra-dural abscess of middle fossa. Phlebitis of the right cavernous and petrosal sinus. The other large venous sinuses showed nothing abnormal and the internal ophthalmic vein was free.

It was clear that a sphenoidal sinusitis had long been latent. Caries had led to infection in the spheno-maxillary fossa, and perforation of the sinus cavernosus. From the former invasion had originated the phlegmon of the face. From the infection of the cavernous sinus had originated the meningitis, pyæmia, coma, etc. The profuse hæmorrhage at the end had come from the cavernous sinus, bursting through the anterior wall of the sphenoidal cavity.

CASE 23 (Duplay, 'Archives Générales de Médecine,' 1874, vol. ii, p. 348).—Female, aged 43. Erysipelas of face three months previously. For a fortnight, acute pain in and around the right eye. For a week the right eye had become enlarged, and there was complete blindness.

On admission, right eyelids red and œdematous. Exophthalmos. Considerable chemosis. Eyeball almost completely immobile. Slight mobility and irregularity of pupil. Fundus oculi could not be seen. The vitreous slightly turbid. Right ear deaf, and oozing blood for 14 days. Old syphilitic lesions in pharynx.

Diagnosis: Syphilitic periostitis of the orbit.

There was no paralysis or spasms, but pulmonary congestion and delirium. The exophthalmos and chemosis appeared to diminish a little. Death after six days.

Post-mortem.—Suppurative phlebitis of the cavernous, coronary, and petrosal sinuses of both sides. Meningitis of the base, and over the frontal lobes. Osteitis, without perforation, of the cerebral walls of the sphenoidal sinus. Chronic non-ulcerating catarrh of anterior region of nose, the mucosa being only thickened and reddened. In the sphenoidal sinuses a perfect collection of pus; the mucous lining was destroyed and the bone bare. Where the lesions were most decided, the osteitis or purulent thrombosis was correspondingly most marked on the cerebral surface of the skull.

The ethmoid cells were similarly diseased, but had not invaded the orbit. Purulent collections around the vessels in the cellular tissue of the orbit. Phlebitis of orbital veins. Optic nerve not diseased, but in almost immediate contact with pus. No lesion in eyeball; vitreous intact. Purulent catarrh of the tympanic cavity, but the neighbouring bone less diseased than more anteriorly, round the foramen lacerum medium, where there was osteitis and abundant pus.

(M. Duplay remarks on the fact that phlebitis of the venous sinuses and the accompanying suppurative meningitis did not give rise to well-marked cerebral symptoms, and only caused hebetude and slight delirium, phenomena that could have been attributed to general feebleness of the pulmonary condition.)

CASE 24 (James Russell, 'Medical Times and Gazette,' 1878, vol. i, June 8th, p. 614).—Man, aged 34, had found himself unusually fatigued by his work for some months. About six weeks before admission had a very bad cold, with copious discharge from the nose and a bad taste in the mouth. Eighteen days before admission suddenly attacked with giddiness and severe pain in head. Then followed acute pain in left temple and behind ears. He vomited frequently. Five days before admission his sight was dim and he had a severe rigor, with subsequent "heats and chills." His mind began to wander and he was delirious.

On admission he was conscious of not possessing full control over his mental operations. There was no derangement in the muscular apparatus of either eye or of the eyelids. Next day, complete proptosis of left upper eyelid, and the globe was immovable. Pupil in medium dilatation, and only oscillated slightly. The right eye retained all its normal power. The patient could be roused to answer a question rationally; but he was fidgety in manner, talked

unconnectedly when left alone, and his talk was "much like a man verging on delirium tremens."

Delirium, rigors, perspiration were noted and the patient passed into a typhoid state. Two days later there was proptosis and chemosis of the left eye, and after two days more he died in coma.

Ophthalmoscopic examination of the affected eye showed no change in the first two days; subsequently the media became somewhat misty, but only sufficiently so to obscure the definition of the vessels, without concealing them. The pupil of the sound eye was persistently contracted during the last three days of life; that of the affected organ (the left) did not undergo any further change. The urine on admission contained one-sixth albumin, with hyalin and granular casts.

Post-mortem.—The sphenoidal and posterior ethmoidal sinuses were quite filled with foetid and very offensive sanious fluid of a blackish-brown colour; the mucous membrane was entirely stripped from the bone and lay in the fluid (compare Cases 18, 34, and 42); the bony walls were not necrosed. The anterior ethmoidal cells were healthy; the frontal sinuses contained a little catarrhal fluid.

All along the body of the sphenoid bone there was a broad effusion of half-decomposed blood beneath the dura. The left cavernous sinus, the circular sinus, and the left ophthalmic vein were thrombosed. All the other sinuses of the dura mater were quite healthy; the longitudinal sinus was nearly empty and the jugular veins normal. The bones of the orbit and all the structures within it were perfectly healthy. Basic meningitis completely surrounded the left third nerve.

The brain was healthy. The kidneys exhibited signs of passive congestion. Other organs healthy.

CASE 25 (Paul Raymond, 'Bulletins de la Société Anatomique de Paris,' LX^e Année, Avril, 1885, p. 226; also described by De Lapersonne, 'Archives d'Ophthalmologie,' vol. v, 1885, p. 445).—Female, aged 40. Suddenly seized with acute pains in left side of head; fever and shivering. Next day pain in left eye, and two days later the sight began to fail as from a mist before the eye, and the upper eyelid became swollen and closed over the eye.

Admitted on the sixth day of illness, there was œdema of the left temporal region and of the upper eyelid, almost entirely

concealing the eye. Chemosis. Pupils dilated and not reacting to light. Complete blindness on left side. Proptosis; no increase of tension. Movements limited in abduction; the other movements still present. Intense pain and tenderness of eye, increased by pressing the globe backwards. Nothing abnormal in right eye. Considerable amount of albuminuria. The eye became quite immobile; œdema spread to left cheek. Professor Panas reported dilatation of the veins of the fundus with slight œdema of the papilla, and diagnosed thrombosis of ophthalmic vein.

Five days after the left eye had been attacked, the right became affected with similar chemosis, palpebral œdema, proptosis, loss of vision, and limitation of ocular movements. Pains diminished. No delirium or convulsions. Prostration. Temperature of 41° C. (105·8° F.), and death in collapse nine days after first symptoms of illness.

Post-mortem.—Extensive suppurative basilar meningitis, especially on left side. The pituitary gland changed into a putrefying, fetid mass. Suppurative phlebitis of left cavernous sinus; thrombosis of right. Ophthalmic veins buried in a serous mass. The quadrilateral plate of the sphenoid was carious and putrid, especially on the left side. It was very thinned and perforated in its centre; all around the bone was rough and riddled with canals. There were no tubercles in the lungs. The kidneys appeared normal, and under the microscope only showed traces of congestion.

CASE 26 (Panas, 'La Semaine Médicale,' No. 31, 29 Juillet, 1885, p. 255; the same case is described by De Lapersonne, 'Archives d'Ophthalmologie,' vol. v, 1885, p. 436).—Male, aged 46. Perfectly well a fortnight before admission, when seized with sore throat, extreme dysphagia, swelling of right cheek, shivering and malaise. Sharp pains in the ear. The swelling of right cheek and throat subsided, although on admission a gangrenous-looking ulcer was still visible on that side, exuding fetid pus. Proptosis of right eye; chemosis; immobility. Pupil dilatable with atrophine, the two reflexes slightly marked. Fundus normal. The other eye is quite mobile. The right ear appeared normal. No albumin and no sugar. A few days later this (left) eye became proptosed and chemotic. Venous stasis of retina. General hyperæsthesia, followed by typhoid conditions. Temperature 40° C. (104° F.), and death two days after admission to hospital.

Post-mortem.—Purulent meningitis of middle and anterior fossæ, more marked on the right side. Suppurative phlebitis of the cavernous, coronary, and petrosal sinuses. The ophthalmic veins on both sides were thrombosed. All the orbital cellular tissue was infiltrated with pus. Pus surrounded the pituitary body, and filled the space between the dura mater and the sella turcica.

The bony tissue of the great wing of the sphenoid on the right side of the sella turcica and of the anterior part of the basilar apophysis was greyish, denuded, and eroded. On section the body of the sphenoid was found friable and dirty grey. The ear on the right side was healthy. (There is no note on the condition of the sphenoidal cavity, but the lesions indicate old-standing sinusitis.)

CASE 27 (J. Thiroloix and C. du Pasquier, 'Bulletins de la Société Anatomique de Paris,' LXVII^e, Année 1892, p. 673).—Female, aged 40. Excellent health till a month previously. Then slight coryza with occipital headaches. For last 14 days atrocious occipital pains, with nocturnal exacerbations. For three days before admission, headache continuous day and night; vomiting; pain in left eye, diminished vision on that side, and diplopia. On examination abundant albuminuria, œdema of legs, temperature 38.8° C. (101.8° F.). Marked exophthalmos, more marked on left; slight œdema of eyelids; inequality of pupils. The œdema of the left eyelid had diminished before death on the tenth day.

Autopsy.—Ecchymoses of the dura mater over petrous bones, basilar apophysis, and wings of sphenoid. Extra-dural abscess over the sella turcica. Basic meningitis, compressing the nerves and vessels going to the eyes. Suppuration in the sphenoidal and ethmoidal cavities. The sphenoidal cavities lined with reddish, thickened membrane. Tissue of orbit œdematous, but not purulent. No pus in the eyes. Old-standing disease of the kidneys.

(Note by St. C. T.—There is no mention of the condition of the ophthalmic veins and the cavernous sinuses, but the symptoms point to their being thrombosed.)

CASE 28 (Claoué, 'Revue hebdomadaire de Laryngologie,' XV, No. 17, 1895, p. 805).—Male, adult. Sudden development of pain in side of head. For six or seven years had suffered from a foetid discharge from left side of nose and frequent migraine.

On examination there was a painful swelling over left nasal bone, and pressure on it increased the discharge from the nose.

Indications of ethmoiditis in left nostril. Caries of upper, left, first molar, and symptoms of a left maxillary sinusitis. Temperature 38° C. (100·4° F.). The tooth was extracted and the sinus drained through an opening in the alveolus. This was followed by improvement, although the temperature remained raised. Four days later œdema of left upper eyelid; pupil dilated and reacting slightly; slight exophthalmos; movements of eye limited. Temperature 39° C. (102·2° F.); slight delirium.

Operation.—Opening through left nasal bone exposing left frontal sinus (containing sero-purulent fluid), and ethmoidal and sphenoidal cavities, from which escaped a considerable quantity of pus; drainage.

There was no improvement. Meningitis became more pronounced, and the patient died in coma two days later, and six days after he was first seen. No *post-mortem*.

CASE 29 (Jassinger, from ref. in 'Revue hebdomadaire de Laryngologie,' vol. xxii, i, 1902, p. 298).—Case of cerebro-spinal purulent meningitis where the pneumococcus of Friedländer was found in pure culture.

Post-mortem showed that infection had spread from the nose to the sphenoidal sinus, which was full of thick, dirty green pus. Thence infection had spread by the vessels of the bony walls to the cavernous sinus. Phlebitis of the cavernous sinus with extension along the nerves to all the cerebro-spinal system.

CASE 30 (Harold Wilson, 'Archives of Otology,' vol. xxxi, 1902, No. 6, p. 443).—Male, aged 34. Four years previously had acute, double suppurative otitis media, with good recovery. Atrophic rhinitis of an ordinary type for several years. No history of syphilis.

Three weeks before admission severe pain in left side of head, with stiffness of neck. Severe chill lasting an hour the day before admission. Temperature 102° 8 F. Pulse 96. There was marked tenderness over posterior portion of mastoid, but not immediately back of the auricle. The membrana tympani seemed slightly reddened.

The left mastoid antrum was opened, and found quite healthy. This was followed by severe pain in region of left ear, rigors, temperatures of 102° to 104·4°, and pulse of 98. No papillitis;

veins somewhat enlarged and tortuous; no neuritis. The left pupil was dilated and sluggish.

Eleven days after first operation the left sigmoid sinus was opened, and dark blood and fluid pus evacuated. As no improvement followed this, the right sigmoid sinus was opened next day and found healthy. The patient steadily grew worse, with pain and stiffness of the neck, perspirations, chills, and drowsiness.

Sixteen days after admission there developed chemosis and proptosis of left eye. Pupil not much dilated, but stabile. Three days later the right eye became protruded and the upper eyelid oedematous. Afterwards the oedema and proptosis of the left eye lessened, so that the upper eyelid could be raised with the finger, exposing the eyeball, which was fixed in position in consequence of the total ophthalmoplegia now observable. The pupil was stabile and only moderately dilated. The patient died comatose 22 days after admission.

Post-mortem.—Abundant suppurative basic meningitis. The sigmoid, superior and inferior petrosal and cavernous sinuses of the left side, the cavernous, superior and (probably) the inferior petrosal of the right side, together with the circular and transverse sinuses, were filled with pus. The pus was offensive. There was a firm thrombus in the anterior half of the superior longitudinal sinus.

Except for the operative openings, the inner surface of both temporal bones was apparently entirely normal. There were no erosions or bony lesions in the floor of the cranial fossæ, except in the region of the sphenoid. Here the superior posterior portion of the body, the dorsum sellæ, was discoloured, softened and eroded. The body of the bone was infiltrated with pus. The soft tissues lining the large cell beneath the pituitary body were injected upon the right side.

The sphenoidal osteo-myelitis—doubtless a result of his long-standing so-called atrophic rhinitis—was evidently the source of all the cerebral and ophthalmic lesions. As the cavernous sinus was not infected early, it is possible that sinus infection first spread to the basilar plexus, thence to the inferior petrosal sinus, and so to the left jugular bulb.

CASE 31 (Walter H. Jessop, "Infective Thrombosis, following Tonsillitis, involving Circular and Cavernous Sinuses; Necrosis of (13411)

Body of Sphenoid Bone; Gangrene of Superficial Part of Frontal Lobe at Base; Meningitis; Death," 'Transactions of the Ophthalmological Society of the United Kingdom,' vol. xxiii, 1903, p. 184).—Male, aged 31. Three weeks previously had "quinsy," but felt better till 10 days before admission, when he had severe headache, followed by vomiting, rigors, and temperature of 104° F. Subject to quinsy; no history or rigors of venereal disease. On admission, slow cerebration, no change in tympanic membranes, no mastoid tenderness. Nothing abnormal found in nose. Slight cloud of albumin in urine. Left eye: Marked proptosis directly forwards; eyelids swollen and œdematous; extreme chemosis; pupils equal and reacting normally; ocular movements good; optic disc a little pink, edges well defined; no swelling or neuritis; vision apparently good. Left eye normal. Left upper eyelid incised, but no pus escaped. Symptoms in left eye increased, but movements were not limited. Slight swelling developed in right lower eyelid, and much swelling of right cheek, with an apparently fluctuating swelling behind palate. This was incised, but only watery fluid escaped. Coma. Death five days after admission, and a fortnight from onset of headache.

Post-mortem.—Offensive brownish-grey purulent basic meningitis. The portion of the sphenoid immediately behind the sella turcica was necrotic, its surface bare and roughened. Both cavernous sinuses and the circular sinus were filled with dirty, offensive pus. A small abscess cavity in orbital fat on left side. Lateral sinuses and jugular veins were not thrombosed. The anterior ethmoidal, sphenoidal, and frontal sinuses were normal on both sides. Ear normal. Jaws nil. Between the internal and external pterygoid muscles on the left side there lay a small collection of dirty-coloured pus.

(Remarks by StC. T.)—The case was evidently regarded as one of infective thrombosis following tonsilitis, and it is remarked that no record could be found of a similar case of acute necrosis of the body of the sphenoid. It is, indeed, difficult to imagine primary necrosis of the sphenoid, except as a result of syphilis. But in this case the possibility of the latter was carefully excluded, it being even noted that there were no signs of scar on the penis. Although it is recorded that the sphenoidal sinuses were "normal" we must regard the disease of the bone as secondary to disease of the mucous membrane—as it is in all pyogenic infections. The

naked-eyed alterations in the mucosa may be slight; pus in the cavity may drain out of it *post-mortem*; and the appearance of the walls of these sinuses in health is not generally appreciated. The symptoms, when compared with other cases, are characteristic of infection spreading from the sphenoidal cavities to the cavernous sinus and the meninges.)

CASE 32 (Beek, 'Rousski Vrach,' 1903, No. 15, p. 574, from ref. in 'Revue Hebdomadaire de Laryngologie,' 1903, No. 35, p. 265).—Male, aged 28, had suffered for two years from headaches with exacerbation. For a month, acute coryza with muco-purulent secretion. Four days before admission sudden onset of spasmodic contractions of muscles of neck, intense headache, fever, swelling of eyelids.

On admission; exophthalmos, papillary stasis. Pus and swelling of turbinals. Violent pain referred to region of frontal sinus. Intellect clouded. Operation on frontal sinus; no pus.

Post-mortem.—Purulent inflammation of both sphenoidal sinuses. Purulent phlebitis of cavernous sinus. Purulent meningitis.

CASE 33 (Beek, 'Rousski Vrach,' No. 15, 1903, p. 574, from ref. in 'Revue hebdomadaire de Laryngologie,' 1903, No. 35, p. 265).—Female, aged 44, had long suffered from headache. Ten days before admission violent pain in left side of head. Temperature, 39° C. (102·2° F.). On 10th day scotoma, exophthalmos, œdema of eyelids and conjunctiva on right side, diminished vision and papillary stasis. Next day œdema invaded right side of face; similar phenomena developed in left eye, with paralysis of external rectus. Nothing abnormal in nose or in the frontal sinus. Death on fourth day.

Post-mortem.—Purulent inflammation of both sphenoidal sinuses, with purulent phlebitis of cavernous sinus. Purulent basic meningitis.

CASE 34. Emile Moreau (from the Clinic of Professor Jaboulay), 'Manifestations Oculo-orbitaires des Sinusites Sphénoïdales.' Thèse de Lyon, 1905, p. 81.—Man, aged 30. Always good health; never syphilis or otorrhœa. Frequent toothache. No pus from nose.

Admitted for large swelling on right cheek and acute pain in head. Incision of right upper gum gave vent to small quantity of pus. Temperature 39·2° C., and 41·4° C. (105° F.). Rigors,

somnolence. On 12th day chemosis of left eye, followed by conjunctival œdema, protrusion of eye, swelling and œdema of eyelids, and total fixation of eyeball. Retro-ocular pain. Mydriasis. Anæsthesia of cornea. Incisions of the left upper and lower eyelids evacuated a few drops of blackish pus. Two days later the same symptoms on the right side. Semi-coma. The fundus showed a white retinal œdema, in the midst of which could be distinguished large, tortuous, dilated veins. No hæmorrhages. Papillary œdema. Operation on sinus by reflecting the nose (Ollier's incisions); ethmoid and frontal sinuses appeared intact; anterior wall of sphenoid broken down, but no pus found on probe. Death same day.

Post-mortem.—Convexity and substance of brain, healthy. Basal meningitis. Pituitary body almost puriform. Both cavernous and both coronary sinuses filled with thick pus; no trace of blood clot. The exterior petrosal and the lateral sinuses, as well as the jugulars, were healthy.

The right sphenoidal sinus was large, quite empty, and showed no trace of pus; its anterior wall had been broken through in the operation. The left sphenoidal sinus was large; contained pus; its mucosa was easily detached with forceps, so as to form a sort of thimble filled with pus. Walls not broken down. Posterior ethmoidal cells healthy. The cellular tissue of the left orbit showed streaks of pus, and in parts was dirt black and sloughy, while the veins were thrombosed. In the right orbit the cellular tissue was œdematous; but no trace of pus, and veins not obliterated. The body of the sphenoid, the basilar process, the tip of the temporal bone on the left side, the roots of the great and lesser wings of the sphenoid, were all blackish, infiltrated with pus, and offensive. The caries extended to the pterygoid processes. Both maxillary sinuses and nasal cavities healthy. On the right side the zygomatic and pterygo-maxillary fossæ contained very fetid pus. On the left the pterygoid fossa seemed infiltrated.

INTRA-CEREBRAL ABSCESS.

CASE 35 (Lévêque-Lasource, 'Journal Général de Médecine,' 1810, p. 368).—Female, aged 38. Illness commenced suddenly with very acute headache, vertigo and somnolence. Diminishing vision, ending in complete double amaurosis. Mydriasis. Slow progress, extending over 15 months, and then death in coma.

Post-mortem.—Serous effusion in the ventricles. Abscess of the pituitary body. Sero-purulent sphenoidal sinusitis on both sides. Destructive osteitis of the posterior clinoid processes and of the sella turcica.

MENINGEAL SEPTICÆMIA (2 Cases).

CASE 36 (Rouge, 'Bulletin de la Société Médicale de la Suisse Romande,' 5me Année, Décembre, 1871, p. 379).—Male, 30. Admitted November 30th for exophthalmus with divergent strabismus and loss of vision left; on same side deafness; nasal voice.

Diagnosis before admission, fibrous polypus at base of skull. Diagnosis by M. Rouge, solid tumour of maxillary sinus.

In June pain in left upper teeth, and first molar removed and the others fell out. In July pains in left eye, which began to project; vision weakened, and at end of a month lost. At same time left nostril obstructed. Ear painful and hearing weakened. At end of October, anæsthesia along sub-orbital nerve. Nasal speech. Dysphagia; but no paralysis. Sharp deep pains all over left side of face.

Operation: left maxillary sinus opened. It contained nothing but very hypertrophied mucous membrane. Patient declared himself quite relieved of his severe pains; but temperature remained at 40° C. (104° F.), pus began to flow freely from the left ear, and on November 27th, *i.e.*, seven days after the operation, he died.

Post-mortem.—Brain and cranial cavity healthy. The left sphenoidal sinus filled with thick, caseous pus, with suppurating periostitis. Chronic suppuration of the middle ear.

CASE 37 (Weichselbaum, 'Medizinische Jahrbücher,' Wien, 1881, p. 227).—Man, aged 20. A healthy soldier, suddenly seized with malaise, headache and giddiness. Complained of pain in forehead, upper jaws and neck. Rapid collapse with contracted pupils, trismus, perspirations, pulse quick and full. He died two days after the first symptoms.

The *post-mortem* was unsatisfactory, and almost negative. The possibility of acute miliary tuberculosis was negatived by the microscope.

However, the examination of the accessory sinuses revealed the cause of death. Suppurative sinusitis of the right sphenoidal
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sinus; less marked in the left. Marked sinusitis in the right maxillary sinus; a lesser degree in the left. Slighter changes in the ethmoidal and frontal cavities.

ENCYSTED ABSCESS.

CASE 38 (A. W. Sandford, 'Transactions of the Ophthalmological Society,' vol. xiv, London, 1894, p. 119).—Male, aged 78. Two and a-half years before death eyesight became suddenly impaired, and subsequently totally lost, from double optic neuritis and post-neuritic atrophy. Complained of no pain, hardly ever spoke, but answered simple questions; no symptoms of paralysis. Two months before death proptosis of left eye developed, with swelling size of a pigeon's egg above the arch of the zygoma. No fever. Death from sheer exhaustion.

Post-mortem showed encysted abscess between layers of dura mater in left middle fossa. It apparently originated in the sphenoidal cells, the walls of which were completely destroyed, while the body of the bone was excavated. It had pierced the wall of the orbit, and appeared externally under the skin in the temporal region.

HÆMORRHAGIC ENCEPHALITIS AND PYÆMIA.

CASE 39 (Schwabach, 'Berliner klin. Wochenschrift,' No. 41, 14 October, 1895. S. 901). — Man, aged 18. High fever and condition diagnosed as inflammation of the lungs. Suppurative otitis media left, and converging right. Considerable albuminuria with casts. Sudden death after 16 days.

Post-mortem showed pus in both middle ears and mastoid antra, as well as in both sphenoidal and maxillary sinuses. The mucosa was very swollen, and yellow-grey. No affection of bone anywhere. The pus contained streptococci. These were all the indications of pyæmia: swelling of the spleen, infarctions, abscess in the lung, etc., and hæmorrhagic encephalitis in the region of the optic thalamus. Schwabach regarded the case as septicæmia consequent on a primary streptococcal infection of the nasal accessory sinuses.

PHLEBITIS OF CAVERNOUS SINUS AND PYÆMIA.

CASE 40 (A. L. Whitehead. A fatal case of necrosis of the sphenoidal and posterior ethmoidal cells; phlebitis of the cavernous sinus; pyæmia. 'The Journal of Laryngology,' vol. xix, April,

1904, p. 179).—Female, aged 47, enjoyed good health up to fatal illness, except for presence of a left-sided, purulent nasal discharge for two years, said to have followed facial erysipelas.

For five weeks frequent and very severe headaches and vertigo. For three days occasional attacks of vomiting, slight rigors, fever, and general malaise. Day before admission uncomfortable feeling of tension in left eye, diplopia and squinting.

On admission, temperature 99°, pulse 110, respiration 28. Both fundi normal, some proptosis left eye and movements of globe restricted in all directions. In nose, thick creamy pus between septum and middle turbinal on left side. Under ether left middle turbinal removed; anterior wall of sphenoidal sinus found soft and carious, and its cavity and that of adjoining posterior ethmoidal cells cleared of pulpy material, pus and granulation tissue. Cavities cautiously curetted and lightly packed. The staphylococcus aureus was found in pure culture in the material removed.

Progress.—No improvement. Headache, proptosis, vomiting; pneumonic consolidation; nose purple and even blackish; cheeks, arms and legs discoloured as in *post-mortem* staining. Temperature 101° to 103° F., pulse 132, respiration 44. Blood showed marked leucocytosis, and a culture gave a pure culture of staphylococci. Death three days after operation—*i.e.*, four days after onset of eye symptoms.

Post-mortem.—Infarcts in lungs and extreme congestion. Pericarditis; fresh vegetations on mitral and tricuspid valves. Infarcts in spleen, and subcapsular hæmorrhages in both kidneys. Walls of left cavernous sinus were softened, thickened, and deeply blood-stained, but the cavity did not contain any *ante-mortem* clot. The anterior wall of the sphenoidal sinus had been partially removed, together with the inner wall of the posterior ethmoidal cells. These cells, together with the sinus, contained blood-stained, semi-purulent fluid; the remaining portions of the walls of these cavities were softened, carious, and deeply blood-stained. No disease was present in the anterior ethmoidal cells, in the antra, in the frontal sinuses, or within the orbit. The brain and meninges were healthy.

INTRA-CRANIAL HÆMORRHAGE.

CASE 41 (C. R. Holmes, 'Archives of Ophthalmology,' vol. xxv, 1896, p. 460).—Male, adult. Suffered from marked nasal stenosis for 20 years. Never at any time profuse discharge from nose. No

headache till influenza four years previously, and since then eyes had troubled him.

Examination with ophthalmoscope negative. Ears normal. No pus in pharynx or in either nasal chamber, but they were practically occluded by enormous swellings of the turbinates. Pain in temples and deep behind the eyes and in the top of the head. Increasing asthenopia. At one time unable to read fine print, although vision was good for distance. Increased weakness of the ciliary muscle. Suddenly seized with intense pain in the head, and death in 12 hours with symptoms of cerebral hæmorrhage.

Post-mortem.—Brain normal. Recent blood clot found covering area of sella turcica, anterior clinoid process, and optic chiasma, and extending forwards towards cribriform plate. On removal, dura mater and roof of sphenoidal cavity were found to be entirely destroyed, so that finger could pass directly downwards to floor of cavity, only encountering puriform secretion mixed with a gritty substance. The floor of the sphenoidal cavity was denuded of periosteum, and superficially eroded. Ethmoidal sinuses were filled with thick pus, and the bone was of a greenish black colour.

The only part of the brain which appeared to be affected was the pituitary body.

Remarks.—From location and appearance of clot evidently a vessel in the region of the cavernous sinus had become eroded and ruptured.

SUPPURATIVE ENCEPHALITIS.

Case 42 (Grünwald, 'Nasal Suppuration,' English Edition, London: 1900, p. 147).—Boy of 14, supposed to have died of tubercular meningitis, of which the infection had proceeded from the nose. For three weeks before death he had been ill with unconsciousness, squinting, and clonic movements of the arms.

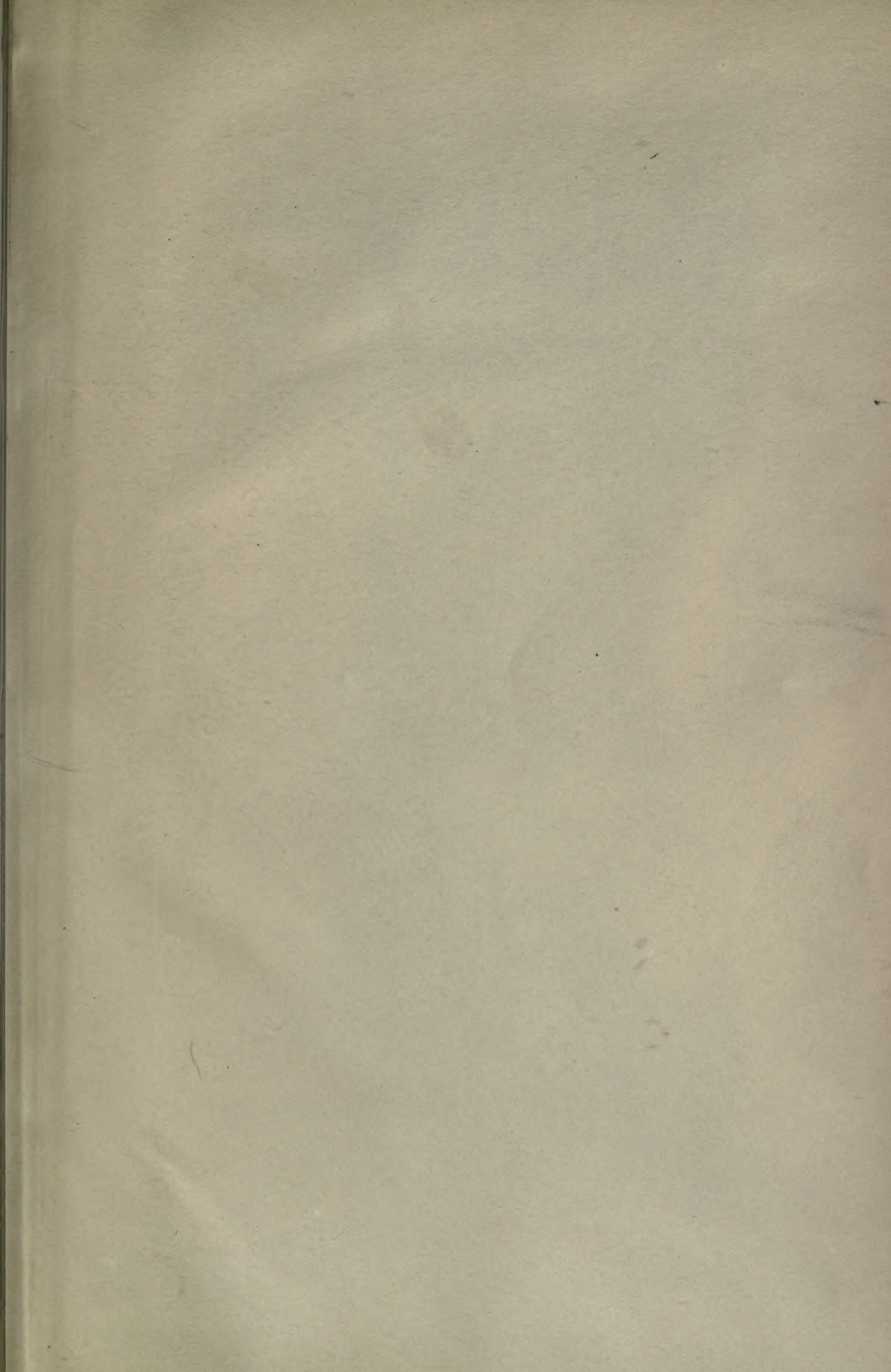
The *post-mortem* did not reveal any tuberculosis. Both lateral ventricles were enormously dilated, and full of clear, amber-coloured fluid—about 300 c.c. At the end of both posterior horns were greenish-yellow brownny masses, beneath which the brain substance was softened and crumbly. The dura mater was everywhere intact.

On removing the roof of the sphenoidal sinus, a greenish-yellow gelatinous mass was exposed between the bone and the lining membrane on both sides. The lining membrane was intact; on

cutting it through, greenish-yellow liquid pus found in both sinuses. (Compare Cases 18, 24, and 34.)

The ethmoid and frontal sinuses were empty. Both antra contained dirty yellowish-green pus. Almost the whole cartilaginous septum was absent, and the edges of the perforation were smooth.

Evidently the nasal suppuration was of old standing, and had led to the perforation of the septum. The exudation lying between the mucous lining and the bony wall of the sphenoidal sinus showed that the infection must have spread by way of the lymphatics and without disease of the bone.



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Title Cerebral and ophthalmic complications in
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